ROLE OF TECHNOLOGICAL AND INSTITUTIONAL FACTORS IN THE AGRICULTURAL DEVELOPMENT OF WESTERN UTTAR PRADESH SINCE 1950-51

ABSTRACT

THESIS SUBMITTED TO
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IN

GEOGRAPHY

BY

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Under the Supervision of

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ABSTRACT

The development of agriculture is a prime concern of planners, economists and geographers and offers a challenge to them to find out means and ways to bring out its overall reform. The development of agriculture implies optimum use of existing land resources with the help of scientific agricultural practices and the application of modern inputs. The development does not only involve an increase in the land productivity but also concerns with the provision of sufficient raw materials to run a number of allied agro-based industries.

Since green revolution which is mainly associated with the discovery of the high yielding varieties of rice and wheat, each and every farmer knows the potentialities of those modern inputs. It is seen that the development of Indian agriqulture depends upon the technological change - a change in the parametre of production function resulting directly from the use of knowledge. The use of technology in agriculture is geared to serve immediate and long term purposes. In the long term purpose, the full employment at progressively rising levels of income is provided for the population which is engaged in agriculture practices.

Western Uttar Pradesh is a fertile area in the northwestern portion of upper Ganga-Yamuna Plain. It is endowed with adequate resources and good climatic conditions which have favoured the practice of agriculture since very beginning. The

growing population of the area directly or indirectly demands more and more foodgrains and the farmers are forced to pay special attention towards the improvement in their agricultural output with an increased use of irrigation, fertilizers, high yielding varieties of seeds and the improvement in infra-structural facilities. There has been an increased in agricultural production but the distributional pattern of all the parameters are not equal in all parts of the region thereby leading to regional disparaties in the agricultural development.

The region is the centre of agricultural activities where about 75 per cent of the region's area and 70 per cent of its population is engaged in agriculture. Due to greater pressure of population per household and per capita land averages are very low. This had led to fragmentation of holdings which with a greater rate of illiteracy does not provide all the year round employment to the rural masses. The total cultivated area of the region was 5,746,781 hectares and the total agricultural production was 49,405,583 metric tonnes in 1990-91.

Western Uttar Pradesh lies approximately between 26^{o} 20^{i}N to 29^{o} 45^{i}N latitudes and 77^{o}E to 80^{o}E longitudes comprising the districts of Muzaffarnagar, Merrut, Ghaziabad, Bulandshahr, Aligarh, Mathura, Agra, Etah, Mainpuri, Moradabad, Budaun, Shahjahanpur, Farrukhabad and Etawah. The districts of Muzaffarnagar, Meerut, Ghaziabad and Bulandshahr occupies the Upper Ganga-Yamuna doab, the districts of Aligarh, Mathura, Agra, Etah, Mainpuri, Etawah and Farrukhabad occupies the central Ganga-Yamuna doab while the districts of Moradabad, Budaun and Shahjahanpur lies outside the doab in the Rohilkhand plains. It forms part of the Indo-Ganga Plain which lies between northern peninsular and the recently built Himalayan chain and is one of the most important plains of the world. The level surface of the plain commanded and traversed by the glacial fed perenial rivers of Himalaya, offers every facility for the construction of great canals.

The region has a well developed drainage system which plays a dominant role for the development of agriculture. The Ganga, Yamuna and Ramganga and their tributaries are the three main systems of the drainage of the study region. This region has no marked surface irregularity. The underground aquifers are supplemented from the main water which sinks easily into the ground. The percolation from major rivers, their tributaries, canal field channels, ponds and tanks also contribute to maintain water level.

The study region is a sub-humid area between the dry Punjab Plain and the humid eastern plain of Uttar Pradesh within the vast monsoonal regime of the great plain. The year is divided into a cold winter season, a hot weather season and a season of general rains. The agriculture follows its own calender with two years of <u>kharif</u> from June to October and <u>rabi</u> season from November to April.

The soils of Western Uttar Pradesh are of the alluvial origin, geologically grouped as khadar, bhangar and tarai variates. The soils of the study region are so uniform and similar in their characteristics that it is often difficult to differentiate the soil of one region from the other.

For better understanding, the whole work is divided into three parts. First part deals with the physical setting of Western Uttar Pradesh and also includes a review of literature to become fully acquainted with the environmental setup of the study area and with the work done so far for the development of agriculture and the factors which are responsible for agricultural development. This part consists of four chapters. The first chapter deals with the structure and relief of the region, chapter second highlights the drainage system of Western Uttar Pradesh and chapter third highlights the climate and soils of the study area. Chapter fourth deals with the review of literature on agricultural development and the factors which are responsible for the development of agriculture.

The second part of the thesis is an analytical study involving five chpaters. The spread and diffusion of technological and institutional factors in Western Uttar Pradesh is dealt in the fifth chapter. Here, all the major technological and institutional factors which are responsible for the development of agriculture in the study region are considered and their spread and diffusion on every tenth year from 1950-51 to 1990-91 is assessed. The net irrigated area of the region was 42.42 per cent and total irrigated area was 40.06 per cent in 1950-51 but it increased to 80.08 per cent and 80.16 per cent respectively in 1990-91. The irrigated area by canals was 50.25 per cent in 1950-51 but it decreased to 22.60 per cent in 1990-91 mainly because pf the onset of tube-well culture. Tube-well irrigation was unknown in 1950-51 but in 1990-91 it commanded 69.41 per cent of the cropped area. The area under other sources of irrigation has decreased considerably. In the year 1950-51 it was 49.72 per cent but it reduced upto 7.79 per cent in 1990-91 mainly due to the installation of tube-wells on a large scale in the region. The high percentage in the net irrigated area was reported in the northern part of the study region and medium range increase was reported in the south central part of the region. The increase in irrigation facilities is the outcome of an increase in the number of pump sets and tube-wells. The increase in irrigated area may be seen as a sign of farmers awakening and the beginning of a revolution which is silently taking place in Western Uttar Pradesh.

It has been observed that there has been a considerable increase in the indicators of agricultural development from 1970-71 to 1990-91 in the study area. The total area covered under high yielding varieties of seeds during 1970-71 was 3,842,541 hectares which went upto 9,185,715 hectares in 1990-91. The use of high yielding varieties of seeds are very common in the northern part and south central part of the study area while the area lying in the eastern part of the region has been slow in adopting this technology.

As far as consumption level of fertilizers is concerned, the NPK consumption has considerably increased in the region in the period of twenty years, i.e, from 1970-71 to 1990-91. The total consumption of fertilizers was 22.37 kg per hectare of cropped area during 1970-71 which shot up at 64.76 kg per hectare of cropped land in 1990-91. The average consumption is higher in the northern and south-central part of the region and low in other parts of Western Uttar Pradesh.

It has been observed that there is a considerable increase in the use of agricultural implements and machinary from 1970-71 to 1990-91. The average number of tractors in 1970-71 was 30.86 per 10,000 hectares of cropped land but it went up to 114.10 tractors per 10,000 hectares of cropped land in 1990-91. This indicates that the level of agricultural development is sharply increasing in the study region.

The number of cooperative banks in Western Uttar Pradesh has increased from 6.02 per lakh of population in 1970-71 to 38.94 cooperative banks per lakh of population in 1990-91.

The number of operational holdings are increasing owing to increasing pressure of population and the prevalent laws of inheritence responsible for the sub-division of holdings amongst the heirs. It is found that two categories of holdings, viz. below one hectare and those with 1 to 2 hectares in size constitute about more than 82 per cent of the total holdings in Western Uttar Pradesh. The other three categories with 2 to 4 hectares, 4 to 10 hectares and above 10 hectares in size constitute only 18 per cent of the total number of holdings in the study region.

There has been a considerable increase in percentage of literate persons to the total population in the study area. The percentage of the literate persons to the total population during 1970-71 was 19.01 per cent and increased to 34.90 per cent during 1990-91.

Chapter sixth deals with the districtwise area, production and yield (productivity) of major agricultural crops in Western Uttar Pradesh. In this chapter all the major crops have been selected and analysed under four groups of cereals, pulses, cash crops and oilseeds from 1950-51 to 1990-91. The growth rates in area, production and yield in the region indicate that among all the crops, cereals are the leading crops. The area under cereals increased in all the quinquennial period except in 1985-90 when it decreased by 396,951 hectares (8.73 per cent). But there is an overall increase in area under cereals to the tune 1,007,753 hectares (32.08 per cent) from 1950 to 1990. The production of cereals recorded a continuous rising trend in all the quinquennial period except in 1970-75 where it decreased by 218,899 metric tonnes (4.16 per cent). The production increased manifolds by 6,182,875 metric tonnes (284.64 per cent) during the study period. The yield also shows a continuous increasing trend during this period. The overall increase in yield of cereals was recorded as 191.20 quintals per hectare. The phenomenal increase has been achieved owing to the introdcution of better seeds, expansion of irrigation facilities, use of fertilizers and pesticides and mechanization. The application of modern agricultural strategy is highly suitable for cereals cultivation. The production of cereals however, was affected by the prevailing dry conditions during 1970-71 owing to which production suffered a loss.

The areal extent of pulses suffered heavily in forty years. The area under pulses shows a continuous declining trend except in two quinquennial periods of 1955-60 to 1980-85. In all the forty years it decreased by 781,120 hectares (67.48 per cent). The production of pulses in the first ten years increased but later it started declining. The total loss was of 424,382 metric tonnes (50.74 per cent) during the study period. The yield of pulses however, shows a mixed trend. The yield during the period of 1950-55 was 1.14 quintals per hectare (15.78 per cent) increased slightly to 3.72 quintals per hectares (51.52 per cent) in 1990-91. Pulses are the main source of protein and therefore, in the light of their decline year after year, require serious attention of the farmers and governmental agencies. Efforts should be directed towards the increase of area and production of pulses. It can be achieved through the adoption of a new varieties of seeds and by safeguarding the interests of the farmers.

A continuous positive growth in area and production of cash crops shows that the region, after getting self sufficiency in the production of foodgrains has turned into commercialised agriculture. It is observed that the area which previously was under the cultivation of pulses is being replaced by the cash crops mainly due to the increase in price of sugarcane and potatoes and creation of better storage and transport facilities. The total increase in area under cash crops was 369,395 hectares (74.69 per cent) during the study period while the production increased by 25,881,932 metric tonnes (189.81 per cent) in the forty years. The yield of cash crops increased manifolds during the same period. During the year 1950-51, the yield of cash crops recorded an increase of 12.75 quintals per hectare but it went upto 181.69 quintals per hectare, an increase of 65.89 per cent.

The area under oilseeds recorded a linear growth of 254,882 hectares (247.40 per cent) while its production increased by 218,319 metric tonnes (355.08 per cent) in the forty years. The yield of cash crops increased by 21.97 per cent from 1950-1990.

The spatio-temporal development of agriculture in Western Uttar Pradesh with special refernce to crop productivity is dealt in chapter seventh. The productivity indices have been calculated on the basis of Yang's Yield formula for the two periods of time, i.e. 1950-51 and 1990-91, considering all the major agricultural crops grown in the study area and grouping them under cereals, pulses, cash crops and oilseeds. The study reveals that in Western Uttar Pradesh the productivity of cereals, cash crops and oilseeds has increased during the study period, i.e. from 1950-51 to 1990-91. The areal extent of high productivity region of cereals has increased by 496.03 per cent and medium productivity region by 44.01 per cent of the area under these categories in 1950-51. While the area under the low productivity region of cereals decreased by 71.49 per cent of the area during the same period. The decrease of area under low productivity of cereals is due to the fact that most of the area has become an area of high and medium productivity in 1990-91.

The areal extent of pulses has decreased heavily under high and low productivity region categories. The area of pulses under high productivity region has decreased by 462,659 hectares (85.31 per cent) and under low productivity region by 391,390 hectares (70.50 per cent) during the study period. But it gained a little area under mediun productivity region, increasing by 50,147 hectares (69.31 per cent) since 1950-51 to 1990-91. The decrease in area under pulses in a matter of concern, since pulses constitute the chief source of protein for the population of the study region. The low yield of pulses shows that it has not been benefited by the modern inputs. The use of indegenous seeds, lack of financial resources and non use of chemical fertilzers make the yield static or even lead to its decline. The improved quality seeds like T-21 and T-44 need to be introduced which can thrive well with less irrigation and give higher net return to the farmers.

The areal extent of cash crops in all the three productivity regions have increased considerably. The area of the cash crops under high productivity region increased by 46,305 hectares (16.51 per cent) during the study period. The highest increase in area of cash crops was recorded under medium productivity region whereas it increased by 403,926 hectares (452.64 per cent) and under low productivity region by 98,774 hectares (145.00 per cent) from 1950-51 to 1990-91. The increase in area under cash crops is due to the decrease in the area of pulses during the study period. It has been observed that the area of pulses is replaced for the production of cash crops in the study region.

The areal extent of oilseeds has increased in all the three productivity regions from 1950-51 to 1990-91. The study reveals that the areal extent of high productivity region of oilseeds has increased by 161,184 hectares (1749.41 per cent), medium productivity region by 177,304 hectares (1027.19 per cent) and low productivity region by 30,097 hectares (52.77 per cent) from 1950-51 to 1990-91. It shows that farmers of the study region are cultivating oilseeds for commercial purposes instead of pulses which shows a continuous decrease in area during the study period. The increase area under oilseeds is mainly due to better farm management, use of good quality seeds and higher net return.

Chapter eight deals with the modern technology and agricultural development in Western Uttar Pradesh. The impact of modern technology on agricultural development is seen by firstly, determining the inter relationship between independent variables and secondly by determining the precise role of various indicators of agricultural development through factor analysis from 1970-71 to 1990-91. The study reveals that there exists inter relationship among independent variables. The results of the analysis for 1970-71 indicate that each variable when considered as a dependent variable has high positive correlation with about 70 per cent of the variables selected. The cooperative banks are having very weak positive correlation with all the variables, size of land holdings is having the negative correlation with all the variables except iron plough and agricultural workers cultivators. While agricultural workers & cultivators have negative correlation with all the other variables except size of land holdings and iron plough.

While studying the inter-relationship among independent variables for the year 1990-91, it is found that each variable is having a high degree of positive correlation with about 74 per cent of the variables selected. Nearly all the variables have negative correlation with size of land holdings and agricultural workers & cultivators.

The results of the factor analysis for the year 1970-71 show that 75.34 per cent of the total variance is explained by two factors. Factor I explains 61.10 per cent of the total variance explained. The highest positive loading is shown by high yiedling varieties of seeds (0.903) followed by tractor power (0.897), irrigation intensity (0.879), tube wells & pumping sets (0.865), seed drills (0.844) and fertilizer consumption (0.840). Factor II accounts for 14.24 per cent of the total variance explained and is strongly loaded with about 28 per cent of the variables selected. The highest positive loading is shown by size of land holdings (0.886) followed by agricultural workers & cultivators (0.796) and iron plough (0.712).

The factor analysis for the year 1990-91 shows that 84.97 per cent of the total variance is explained by three factors. Factor I accounts for 62.53 per cent of the total variance explained. The positive sign of variables is associated with the higher development of agriculture and infra structure. Irrigation (0.942), fertilizer (0.965), tractorization (0.921), tube wells & pumping sets (0.901) and high yielding varieties of seeds (0.822) are all loaded high and positive on this factor.

The positive relationship among these variables of agricultural development is because the use of fertilizers and HYV seeds require high doses of irrigation. Mechanization constitutes an increasing ingredient of modern agriculture.

Factor II accounts for 13.65 per cent of the total variance explained and is closely related with variables of cooperative banks (0.915).

Factor III which explains 8.79 per cent of the total variance explained and is positively loaded on size of land holdings (0.916), agricultural workers & cultivators (0.732) and seed drills (0.455).

The results of the factor analysis performed for three agricultural productivity regions in Western Uttar Pradesh for the year 1990-91 shows that the rotated factor matrix for each of the three regions recorded two factors but the per cent of the cumulative variance explained are dissimilar. In the high productivity region, the total variance explained is 79.23 per cent. Factor I recorded 58.90 per cent of the total variance explained and have positive loadings on about 66 per cent of the total variables selected. These are tube well & pumping sets, tractor power, fertilizer consumption, high yielding varieties of seeds, irrigation intensity, rural electrification, cooperative banks and literacy rate.

Factor II explained 20.23 per cent of the total variance explained and has high positive loading on about 16 per cent of the total variables. These are seed drills and tractor power.

Medium productivity region recorded 75.02 per cent of the total variance explained by two factors. Factor I explained 48.33 per cent of the total variance explained and is strongly loaded on about 33 per cent of the total variables selected. Factor II recorded 26.68 per cent of the total variance explained and has high positive loadings on seed drills (0.768) and tractor power (0.909).

Low productivity region explained 25.40 per cent of variance by two factors. Factor I which explained 30.15 per cent of the total variance is strongly positively loaded on about 25 per cent of the variables. Factor II recorded 45.25 per cent of the total variance explained and has high positive loadings on about 25 per cent of the total variables selected.

In the high productivity region, the combination I comprises of tube wells & pumping sets, tractor power, fertilizer consumption, high yielding varieties of seeds, irrigation, intensity, rural electrification, cooperative banks and literacy rate. This combination is ideally suited for the development of agriculture in Western Uttar Pradesh.

In the medium productivity region, there are two combinations, i.e. Combination II which is comprises of tube wells & pumping sets, fertilizer consumption, high yielding varieties of seeds and irrigation intensity and combination III comprising of the variables of seed drills and tractor power.

In the low productivity region, combination IV comprised of the variables of tube wells & pumping sets, high yielding varieties of seeds and irrigation intensity and combination V which is combined with the variables of seed drills, fertilizer consumption, size of land holdings and agricultural workers & cultivators are well suited for agricultural development in the study region.

The results of the study indicate that the impact of the independent variables is less significant for agricultural development of the Western Uttar Pradesh as a whole in comparison to the three regional productivity areas of this plain. The results further substantiate that the regional sensitivity of the packages of variables have different influence in different agricultural development regions. This does not mean that these packages will not have similar effects in the region, instead it reveals causes of variation in regional development of agriculture.

In the ninth chapter the levels of agricultural development in Western Uttar Pradesh from 1970-71 to 1990-91 has been assessed. The levels of agricultural development in the region are seen in three respect, i.e. the changed cultivated area is correlated with the change in modern technology, the changed agricultural production is correlated with the change in modern technology and finally the changed agricultural productivity is correlated with the change in modern technology. The study reveals that about 50 per cent of the districts have increased their agricultural area between the garde of 0 to 100,000 hectares and about 14 per cent above 100,000 hectares in 1990-91. About 35 per cent of the total districts have decreased their area between the grade of 0 to -100,000 hectares except Meerut district in 1990-91. When the change in cultivated area is correlated with the change in technological variables, it is found that about 33 per cent of the variables are directly proportional to the changed area. Only the size of land holdings has a high positive coorelation.

About 40 per cent of the districts which have increased thier production in the grade of above 1,000,000 metric tonnes lie in the Ganga-Yamuna doab and in the eastern and northeastern parts of the study area. About 20 per cent of the districts fall between the grade of 500,000 to 1,000,000 metric tonnes increase in agricultural production. About 21 per cent of the districts increase their agricultural production between the grade of 100,000 to 500,000 metric tonnes and about 14 per cent of the districts have increased their agricultural production in the grade of below 100,000 metric tonnes. The study reveals that there exists some relationship between the changed agricultural production and change in independent variables but this relationship is weak and not uniform. About 75 per cent of the variables are directly proportional to the development of agricultural production in Western Uttar Pradesh.

While studying the change in agricultural productivity and changed in the variables of agricultural development, it is found that about 21 per cent of the districts have decreased their agricultural productivity index between the grade of 0 to -20 quintals per hectare and above -20 quintals per hectare. Nearly 21 per cent of the districts have a marginal positive growth of agricultural productivity between the grade of 0 to +20 quintals per hectare. About 56 per cent of the districts have increased agricultural productivity above 20 quintals per hectare. The study reveals that the changed agricultural productivity has high degree of positive relationship with tube wells & pumping sets, iron plough, tractor power, fertilizer consumption, high yielding varieties of seeds, irrigation intensity and rural electrification.

The part third of the thesis is devoted to summary. The researcher has suggested some measures to overcome the problem of inter-district variations in chapter tenth. The overall assessment of the problem reveals large variations in the agricultural development at micro level in Western Uttar Pradesh. The general distributional pattern of agricultural development shows a marked decline from north to south. This pattern is in close confirmity with the variations in the level of agricultural technology.

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Dedicated to my
Beloved Parents

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Dated : 04 October, 1994

This is to certify that **Mr. Waliullah Khan** has completed his Ph.D. thesis entitled, **"Role of Technological and Institutional Factors in the Agricultural Development of Western Uttar Pradesh since 1950-51"**, under my supervision. His thesis in my opinion is based on original research and, I am sure, it will prove to be a great contribution to the field of agricultural development.

(M. Farooq Siddiqi)

CONTENTS

PART II

TECHNOLOGICAL AND INSTITUTIONAL FACTORS, AGRICULTURAL PRODUCTIVITY AND AGRICULTURAL DEVELOPMENT: AN ANALYTICAL ASSESSMENT

ACKNOWLEDGEMENT

I feel privileged in expressing my profound sense of gratitude and indebtedness to **Prof. M. Farooq Siddiqi**, Department of Geography, Aligarh Muslim University, Aligarh, for suggesting the problem, extending his invaluable guidance, constant help and encouragement during the entire course of this investigation. I am also thankful to **Prof. K. Z. Amani**, Chairman, Department of Geography, Aligarh Muslim University, Aligarh, for providing all the necessary facilities in the Department.

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My humble feelings of gratitude are to my **parents**, brother **Dr. Samiullah Khan**, Lecturer, Department of Botany, Aligarh Muslim University, Aligarh, bhabhi **Dr. (Mrs.) Suhail Anver**, Research Associate, Department of Botany, Aligarh Muslim University, Aligarh and little baby **Hira**, who, together kindled the flame of learning in me and to whose encouragement, affection and sacrificial devotion I ascribe all my successes.

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Waliullah Khan

(WALIULLAH KHAN)

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

It is a fact that even after more than forty years of independence and planned development with special emphasis on agricultural development, achieving and sustaining self suffiency in food production remains our primary concern. One explanation for our impasse is our increasing population. We are adding, each year, something like the population of Australia to our numbers. We will be one billion by the turn of the century and over 1.5 billion by the time our population gets stabilized. What these facts convey is that in the future we will need to produce more and more from a progressively diminishing natural base. The cultivated area of the country remained nearly constant at 140 million hectares over the past two decades. The net per capita availability of cultivated land which was more than 0.3 hectares in the 1950s will stand reduced to less than 0.14 hectares by the turn of the century.

Even at moderate levels of foodgrain consumption we will need 235 million tonnes of foodgrain by the year 2000. Between the decade 1980-81 and 1990-91, the foodgrain production increased by about 40 million tonnes. Over the next ten years period we will need to increase production by about 65 million tonnes. In the fifties and sixties, extension in the cultivated area contributed substaintially to increase in foodgrain production. But in future, there appears no scope, whatsoever, to expand the area under cultivation. Keeping this fact in mind the government introduced high yielding varieties of rice, wheat and other crops in relatively well endowed areas which brought green revolution in the country. It was during this period that a large number of state agricultural universities were established which provided a strong research base for generating and spreading technologies.

Since green revolution which is mainly associated with the discovery of the high yielding varieties of rice and wheat, each and every farmer knows the potentialities of those modern inputs. It is seen from the present work that the development of Indian agriculture depends upon the technological change- a change in the parameter of production function resulting directly from the use of knowledge.

The use of technology in agriculture is geared to serve immediate and long term purposes. In the long term purpose, the full employment at progressively rising levels of income is provided for the population which is engaged in agriculture practices.

The institutional factors have their own importance. These factors are highly responsible for the development of agricultural production. A single word 'land reform' is used to increase the productive efficiency of land.

In view of the importance of technological and institutional factors, the author in the present work has tried to assess the role of these factors in the agricultural development in Western Uttar Pradesh since 1950. Western Uttar Pradesh has been selected as the study area because this region basically is an area where agriculture is the predominant occupation of the people engaging directly or indirectly of about 70 per cent of the total population.

The main objectives of the study are:

1. To take into account the physical base of the region which provides basic framework for the practice of agriculture.
2. To study the spread and diffusion of technological and institutional factors in the region.
3. To assess and analyse the trend in area, production and yield of major crops of the region.
4. To examimne the spatio-temporal development of agriculture with special reference to crop productivity in the study area.
5. To study correlation between technology and agricutural development in the region.
6. To examine the levels of agricultural development of the study area.
7. To suggest suitable guidelines for future development of agriculture in Western Uttar Pradesh.

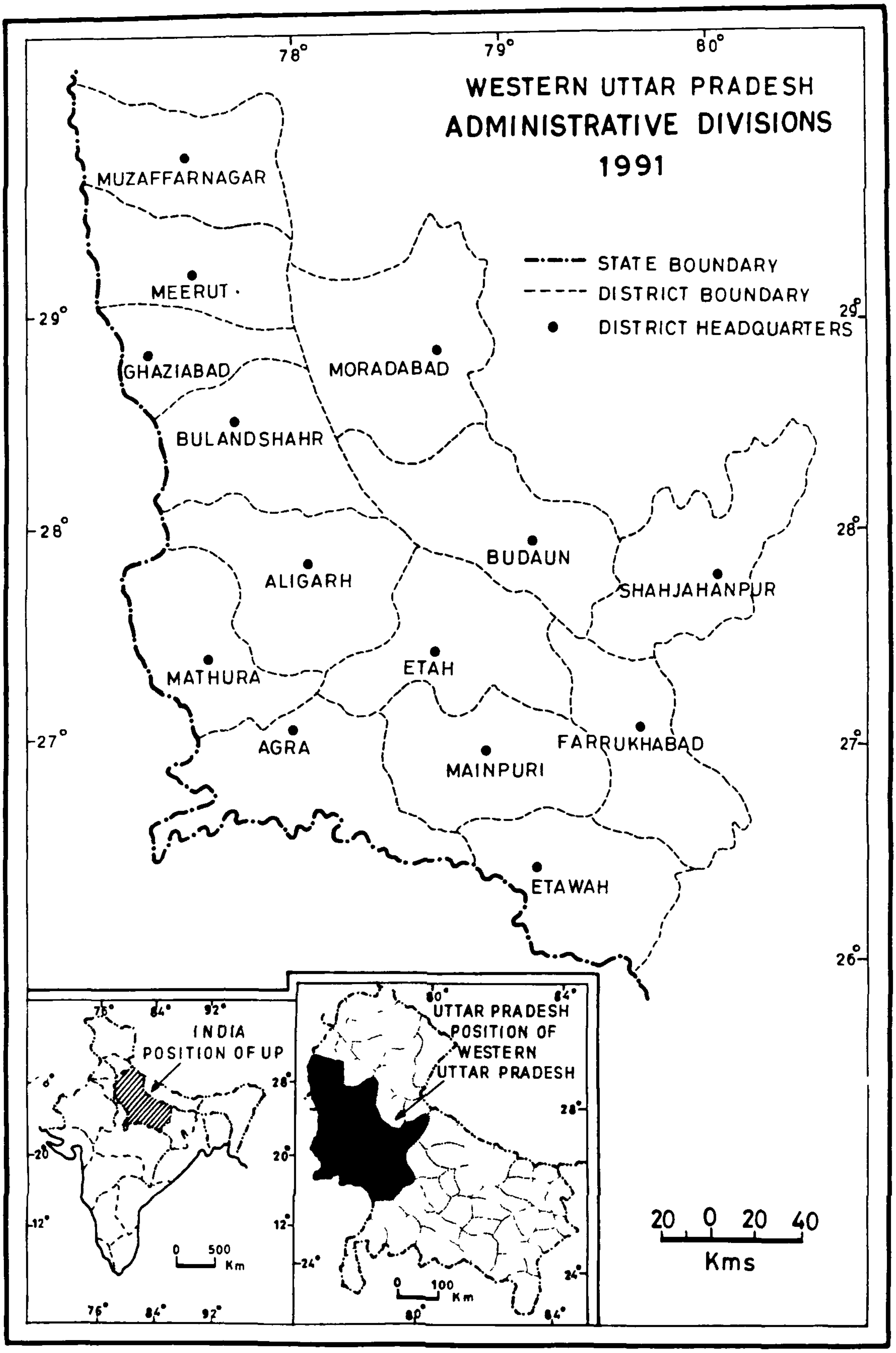
/Western Uttar Pardesh, the study area is the most developed and prosperous region of the state of Uttar Pradesh but the intra-district imbalances can be seen. The backward areas lack adequate infra-structure. Because the variations in the levels of the development in various districts are accompanied by equally sharp variations in infra-structure facilities. The region is the center of agricultural activities from the very beginning because of its fertile soil, level topography and suitable climatic conditions. About 75 per cent of the region's area and 70 per cent of its population is engaged in agriculture. Due to greater pressure of population per household and per capita land averages are very low. This had led to fragmentation of holdings which with a greater rate of illiteracy does not provide all the year round employment to the rural masses. If the economy of the masses has to be improved, it is imperative that agricultural production should increase at a faster rate.

The region occupies the fertile north-western portion of the upper Ganga Plain which is well endowed with water resources and good climatic conditions which have favoured agricultural development. The total cultivated area of the region was 5,746,781 hectares and the total agricultural production was 49,405,583 metric tonnes in 1990-91. According to the census of India 1990-91, the total population of the region was 36,502,598 persons.

Western Uttar Pradesh lies approximately between $26^{o}\ 20'$ N to $29^{o}\ 45'$ N latitudes and 77^{o} E to 80^{o} E longitudes comprising the districts of Muzaffarnagar, Meerut, Ghaziabad, Bulandshahr, Aligarh, Mathura, Agra, Etah, Mainpuri, Moradabad, Budaun, Shahjahanpur, Farrukhabad and Etawah. The districts of Muzaffarnagar, Meerut, Ghaziabad and Bulandshahr occupies the Upper Ganga-Yamuna doab, the districts of Aligarh, Mathura, Agra, Etah, Mainpuri, Etawah and Farrukhabad occupies the Central Ganga-Yamuna doab while the districts of Moradabad, Budaun and Shahjahanpur lies outside the doab in the Rohilkhand plains. It forms part of the Indo-Ganga Plain which lies between nothern peninsular and the recently built Himalayan Chain and is one of the most important plains in the world. The level surface of the plain commanded and traversed by the glacial fed perenial rivers of the Himalaya, offers every facility for the construction of great canals.

The region has a well developed drainage system which plays a dominant role for the development of agriculture. The Ganga, yamuna and Ramganga and their tributaries are the three main systems of the drainage of the study region. This region has no marked surface irregularity. The underground aquifers are supplemented from the rain water which sinks easily into the ground. The percolation from major rivers, their tributaries, canal field channels, ponds and tanks also contribute to maintain ground water level.

The study region is a sub-humid area between the dry Punjab plain and the humid eastern plain of Uttar Pradesh within the vast monsoonal regime of the great plain. The year is divided into a cold winter season, a hot weather season


WESTERN UTTAR PRADESH
ADMINISTRATIVE DIVISIONS
1991
STATE BOUNDARY
DISTRICT BOUNDARY
DISTRICT HEADQUARTERS
78°
79°
80°
29°
28°
27°
26°
MUZAFFARNAGAR
MEERUT
GHAZIABAD
MORADABAD
BULANDSHAHR
BUDAUN
ALIGARH
SHAHJAHANPUR
MATHURA
ETAH
AGRA
FARRUKHABAD
MAINPURI
ETAWAH
INDIA
POSITION OF UP
0 500 Km
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POSITION OF
WESTERN
UTTAR PRADESH
0 100 Km
20 0 20 40
Kms

FIG.1

and a season of general rains. The agriculture follows its own calender with to years of Kharif from June to October and rabi season from November to April.

The soils of Western Uttar Pradesh are of alluvial origin, geologically grouped as Khader, bhangar and tarai variates. The soils of the study region are so uniform and similar in their characteristics that it is often difficult to differentiate the soil of one region fronm the other.

For better understanding, the whole work is divided into three parts. First part deals with the physical setting of Western Uttar Pradesh and also includes a review of literature to become fully acquainted with the environmental setup of the study area and with the work done so far and the problems involved in this area. This part consists of four chapters. The first chapter deals with the structure and relief of the region, chapter second highlights the drainage system of Western Uttar Pradesh and chapter third highlights the climate and the soil of the study area. Chapter forth deals with review of literature on agricultural development and the factors which are responsible for the development of agriculture.

The second part of the thesis is an analytical study involving five chapters. The spread and diffusion of technological and institutional factors in Western Uttar Pradesh is dealt within the fifth chapter. Here, all the major technological and institutional factors which are responsible for the development of agriculture in the study region are considered and their spread and diffusion on every tenth year from 1950-51 to 1990-91 is assessed. The factors which are considered in this chapter are irrigation which is the surest way for increasing the agricultural productivity, high yielding varieties of seeds which can increase the agricultural productivity very much if the chemical fertilizers and well irrigation facilities are provided, fertilizers which play a catalyst role in the development of agriculture, by replacing the age old agricultural impliments and machineries such as tractors, pumping sets and harvestors can increase the production of foodgrains, cooperative banks, land holdings and literacy.

Chapter sixth deals with the districtwise area, production and yield (productivity) of major agricultural crops grown in Western Uttar Pradesh. In this chapter all the major crops have been selected and analysed under four groups of cereals, pulses, cash crops and oilseeds from 1950-51 to 1990-91.

The author has examined the spatio-temporal development of agriculture in Western Uttar Pradesh with special reference to crop productivity is dealt in chapter seventh. The productivity indices have been calculated on the basis of Yang's yield formula for the two periods of time, i.e. 1950-51 and 1990-91, considering all the major agricultural crops grown in the study area.

Chapter eight deals with the modern technology and agricultural development in Western Uttar Pradesh. In this chapter, the researcher has tried to assess the role of technological and institutional factors in the study area. Firstly, an attempt has been made to determine the inter-relationship among the independent variables during the periods of 1970-71 and 1990-91 and secondly, the precise role of various indicators of agricultural development is determined through factor analysis.

The researcher has examined in the ninth chapter the levels of agricultural development and has assessed how far it is influenced the change in the magnitude of technological and institutional variables. The chapter is divided into three parts. The first part deals with the change in cultivated area and its correlation with the change in technological and institutional variables. The second part is devoted to explain the change in agricultural production and the extent of the influence of change in selected variables and the third part deals with the change in agricultural productivity and its correlation with the change in selected variables.

Finally, the third part of the thesis is devoted to the summary. In the chapter tenth the researcher has suggested measures to be undertaken in order to overcome the problem of hungers by proper agricultural development of the area.

PART - I

PHYSICAL SETTING OF WESTERN UTTAR PRADESH AND A REVIEW OF LITERATURE

CHAPTER I

STRUCTURE AND RELIEF

1.0 Western Uttar Pradesh structurally forms part of the Indo-Ganga plain, which lies between the ancient southern penninsula and the recently formed Himalayan chain. This is one of the most important plains in the world. It is characterised by monotonous flat surface broken at places by small mounds and village settlements. The whole of Western Uttar Pradesh likewise has a level surface with imperceptible slope of Kilometer. This region lies at an elevation of 150-300 meters above the mean sea level. The Himalayas rise abruptly in the north of the plain and have greatly influenced the hydrology of the rivers which flow from them towards this plain. The region is composed of alluvium brought by the Himalayan rivers, Ganga, Yamuna and Ramganga. The alluvium thus deposited is of universe thickness, enormous width and of uniform character. The absence of any marked surface irregularity permit the rains to sink into the ground, which together with water percolating from major rivers and their tributaries maintain this subsoil water table at level which can be easily tapped (Williamson, 1925).

1.1 Several theories try to explain the origin of the Indo-Ganga plain. According to Suess, an Australian geologist, it was a foredeep formed in front of the resistant mass of the peninsula after the Tethyan sediments were thrust southward, and compressed against the peninsula resulting in the uplift of Himalayan chain. The rivers rising from the Himalayas brought an immense quantity of detritus and deposited it in this foredeep. The deposition of the alluvium continued althrough the Pleistocene period upto the present and led to the formation of the plain.

On the other hand, on the basis of geodetic observations, S. G. Burrad found a zone of low density underlying the Indo-Ganga alluvium, and concluded that the presence of this underlying matter of low density points to a rift valley which was formed by tension in the crust leading to crustal opening[1].

Another view has been put forward by Oldham, who suggests that the crust of the earth is floating upon a fluid magma, and therefore, the trough has been created by the sinking of the crust under the weight of alluvial deposit brought down from the mountain by rivers[2].

A more recent theory which seems more convincing about the formation of the plain ascribes its origin to the intense mountain building movement which produced a depression or a foredeep in front of the convex side of the Himalayan arc.

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1. **Burrad, S.G.,** "Proceeding of the Royal Society of England", Vol.XCI-A, 1914-15, p. 223

2. **Burrad, S.G.,** ibid, p. 223

Owing to the bending down of the nothern edge of India, which came in opposition to central Asian masses[3].

1.2 As regards the thickness of the alluvium reliable information is derived from borings that have been carried out in Uttar Pardesh. Some borings have been put down in the alluvial deposits to a depth of above (2000 ft.) for tapping water[4]. At Lucknow about 180 Km north of the south edge of the Yamuna-Ganga basin, the deepest of all the bore holes in the Gangetic alluvium was made to a depth of about 400 m (1336 ft) below sea level[5]. The beds which were encountered during the borings were of the same character from top to bottom and consisted of sand and sandy silt with occasional beds of Kankar. The bottom of alluvium at Agra is only 1.5 m (5 ft) above sea level.

1.3 Geologically the alluvial deposits of the Western Uttar Pradesh are classified roughly into two types: (1) Khadar or newer alluvium and (2) bhangar or older alluvium. These deposits corrospond in age with the Pleistocene and recent periods of geological history.

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3. **Krishnan, M.S.,** "The structure and Tectonic History of India", Memoirs of the Geological Survey of India, Vol.81, Calcutta, 1953.

4. **Krishnan, M.S.,** Introduction to the Geology of India, Madras, 1944, pp. 169-70

5. **Oldham, R.D.,** "The Deep Boring at Lucknow", Records of the Geological Survey of India, Vol. XXIII, p. 263

The bhangar lands occupy the higher ground and are not flooded by rivers during the rains[6]. The area under the older deposits is much more extensive than that under the new deposits. The older deposits generally contain Kankar nodules of all sizes and shapes from small grain to big lumps. These deposits are also characterized by the patches of saline and alkaline efflorescence, which are due to the gentle slope of the land and the composition of the alluvium. The Himalayan rivers and the tributaries bring various salts in solution which percolates in the sub-soil of the area they traverse. In the areas where there is no proper surface drainage, these salts keep on accumulating by leaching from the neighbouring areas. During dry season, the soluble salts are drawn up in solution by capillary action to the surface and are deposited there in the form of a white efflorescence. The most important material in bhangar lands is clay, which at places becomes loam or sandy-loam.

The Khadar, relatively rich in plant nutrients, is a newely occupy the deposited alluvium in the narrow flood plain of the rivers. Neutral to alkaline in reaction (pH 6-8), these are deficient in organic materials specially phosphorous, and

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6. **Shafi, M.,** Land Utilization in Eastern Uttar Pradesh, Aligarh 1960, p.3

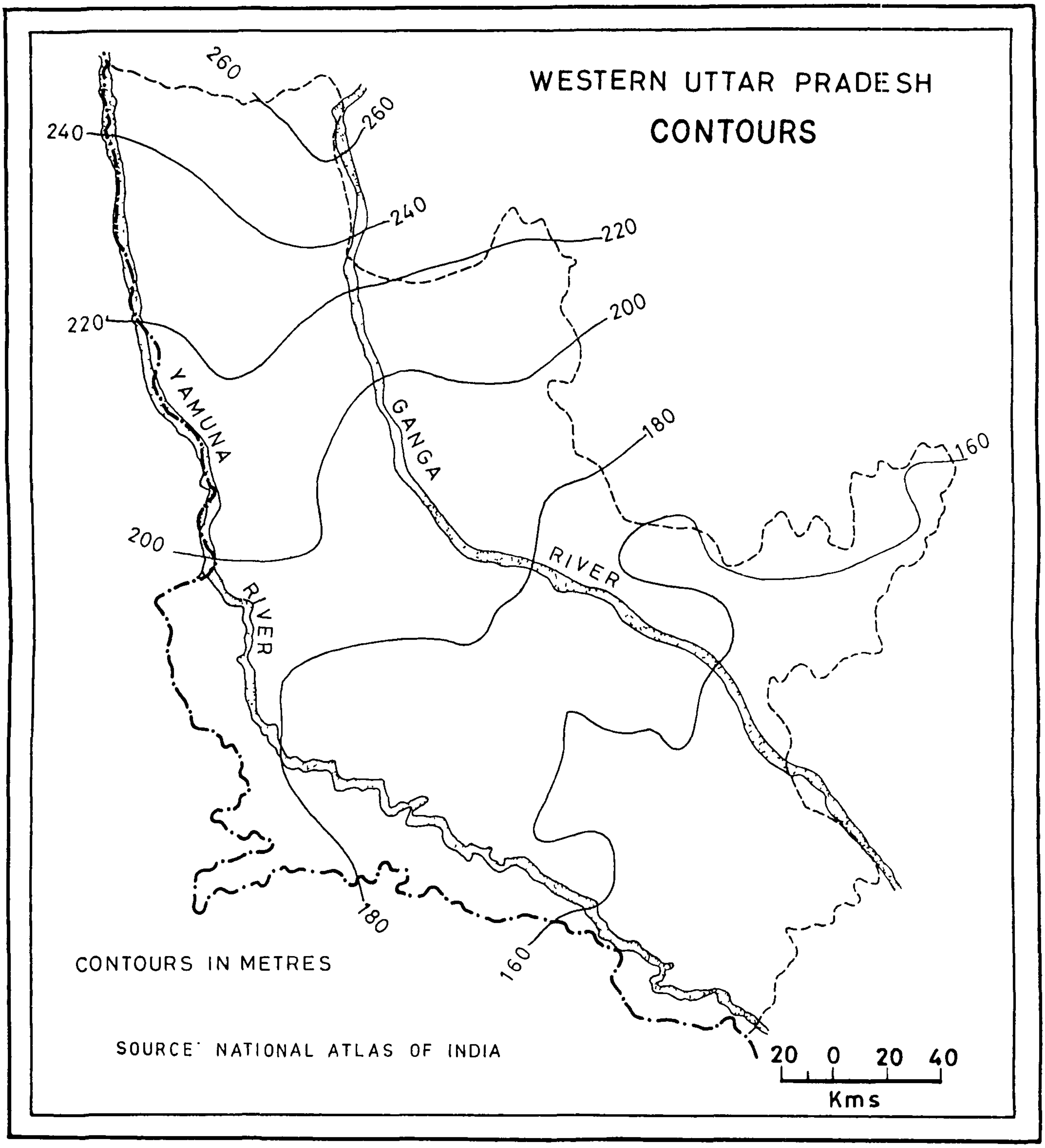
WESTERN UTTAR PRADESH
CONTOURS
260
260
240
240
220
220
200
200
180
180
160
160
YAMUNA
RIVER
GANGA
RIVER
CONTOURS IN METRES
SOURCE: NATIONAL ATLAS OF INDIA
20 0 20 40
Kms

FIG.2.

are sandy to loamy in texture. Locally, as observed by Puri[7]. The Ganga Khadar have immature profiles with sandy to silty loam texture lack of Kankar concentration, fair proportion of lime and other soluble salts and are alkaline in reaction (pH 8) with imperfect drainage while the Yamuna Khadar have sub-mature profile with pre-dominance of clay and concretion and very high lime and other soluble salt contents under ill-drained condition. (Figure 2)

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7. **Puri, G.S.**, Indian Forest Ecology, Oxford Book and Stationary Co., New Delhi, 1960, p.548, quoted from **Singh, R.L.**, India: A Regional Geography, Varanasi, 1971, p.136

CHAPTER II

DRAINAGE

2.0 Surface Water

The drainage follow the general slope of the region and rises roughly from north to south and south east in the Western Uttar Pradesh. The whole region is divided into three broad drainage basins, each commanded by the rivers Ganga, Yamuna and Ramganga together with their tributaries (Fig.3). These are perinial rivers originating from the Himalayas from where they get a continous supply of water from melting snow in late winter and summer and from rainfall during the monsoons. The rivers Yamuna and Ramganga are the tributaries of the Ganga but in view of their individual importance, these have been treated as seperate systems.

2.0.1 The Ganga has a very large basin and it is the most important river of this region. After rising in Gangotary glacier in the Himalayas, it enters the upper doab plain at Haridwar through a well defined gorge in the siwaliks. The solani river joins the river Ganga in Muzaffarnagar district, the river enters the district of Meerut and seperates it from the districts of Bijnor and Moradabad. Later on it forms the eastern boundary of the districts of Bulandshahr, Aligarh, Etah and Faurrukhabad and also seperates the districts of Moradabad, Badaun and Shahjahanpur on to its eastern side.

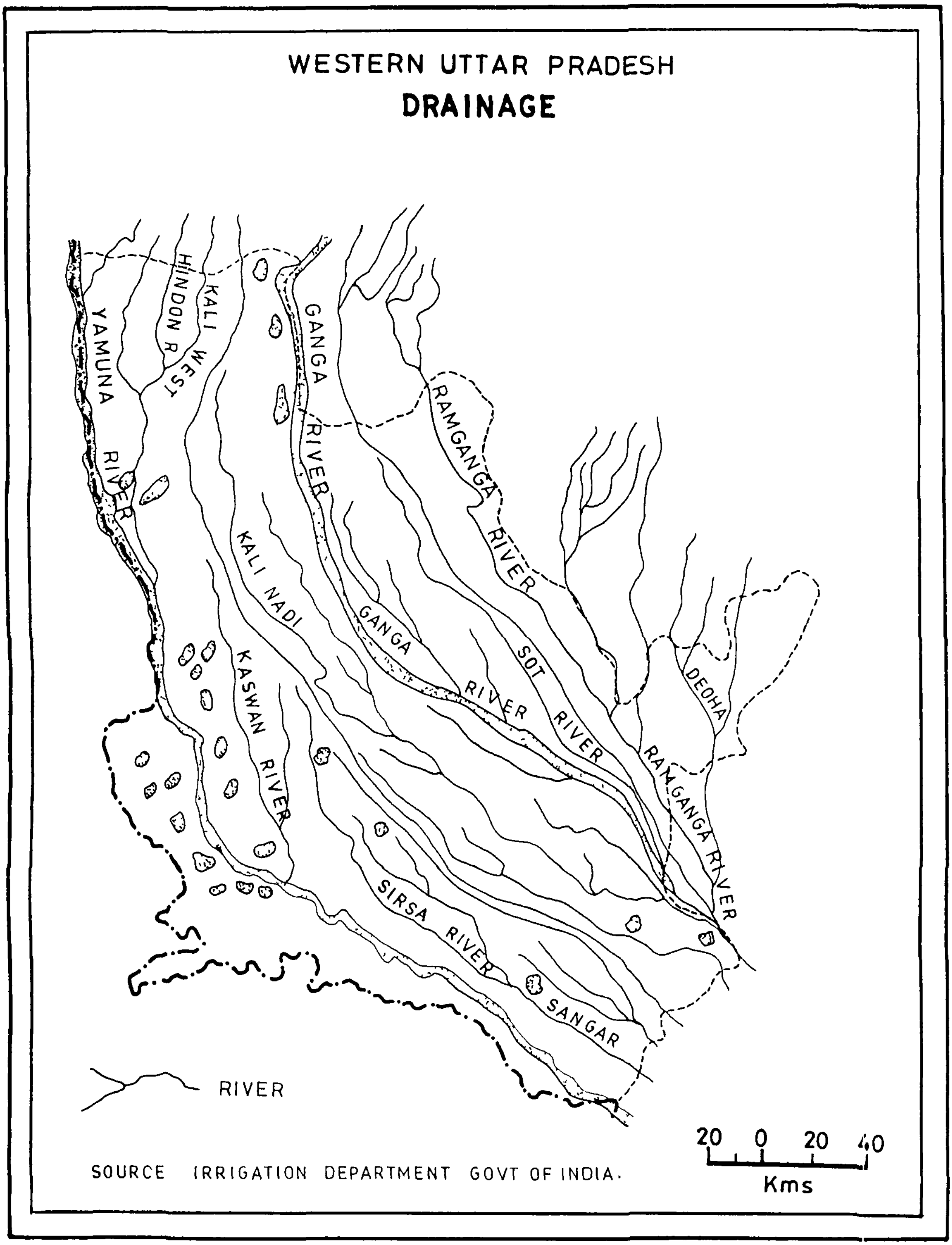
WESTERN UTTAR PRADESH
DRAINAGE
YAMUNA RIVER
HINDON R
KALI WEST
GANGA RIVER
RAMGANGA RIVER
KALI NADI
GANGA RIVER
SOT RIVER
DEOHA
RAMGANGA RIVER
KASWAN RIVER
SIRSA RIVER
SANGAR
RIVER
SOURCE IRRIGATION DEPARTMENT GOVT OF INDIA.
20 0 20 40
Kms

FIG.3

In the region, it roughly in a south, south-easterly direction through a long course and gathers water from its tributaries. The important tributaries that join the river Ganga in Western Uttar Pradesh are the Yamuna, Ramganga, Kali nadi, Nium Wadi, Isan nadi, Tista, Burdanar, Chhoiya, Bhainsaur and Sot. Some of these tributaries are seasonal and increase their volume during the rainy season.

2.0.2 The Yamuna, second major river of Western Uttar Pradesh rises in the region of Jumnotri at a hieght of 6216.9 meter. It forms the western boundary of many districts of Western Uttar Pradesh such as Muzaffarnagar, Meerut, Bulandshahr and Etawah. Generally it flows in south, south-easterly direction.

The course of river Yamuna is quite irregular along the parganas of Bidauli, Kairana and Kandhla of Muzaffarnagar district. At Madhopur, 5 Km to the north-west of Kairana, it is joined by a small stream called Katha. The banks of the river remains high in water but as the river flows towards south in the district of Meerut, the height of banks is reduced considerably. Here the Khadar deposits along the river is very small. The Hindan nadi joins the river Yamuna near Dadri in Bulandshahr district. The width of the bed of the river in Mathura is about 5 Km. It enters into Agra with a great loop, making the common boundary of the two districts only for a short distance. The average depth at Agra is about 3 m.

The course of the river becomes much wider in Mainpuri district because of the fact that it flows through soft and sandy loam which is more liable to erosion. The most prominent bends of the river in Mainpuri district are found at Punchha and Pariyar. One loop of about 14 Km length is at Horah while another has developed near Dandauli village. The river makes the boundary between Agra and Etawah districts for about 24 Km. Before receiving the waters of Chambal river, it forms the boundary of Jalaun and Etawah districts. The tributaries of the Yamuna are Hindan, Karwan, Rind, Chambal, Senger, Sirsa and Utangan. Most of these tributaries are seasonal.

2.0.3 Ramganga is another important river of this region. Though it is a perenial stream coming out from the Himalayas and has well defined course, yet the area under its course is liable to continous change owing to shifting of river bed. As a matter of fact, the surface of the land where it flows is subjected to annual inundation and deposition of fine sand and silt, similar in character to that of the river Ganga.

The eastern low-land of Budaun district consists of numerous lakes, small and large water channels, marshes, other land depressions and waterlogged patches of land which all are the vestiges of ancient bed of the river Ramganga and are now locally known as "bankati" in the Budaun district[1]. The

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1. **Siddiqui, A.H.,** "A Regional Survey of Budaun District of U.P.", The Indian Congress Journal, Vol.XXV, Jan.-March, 1950, p.17

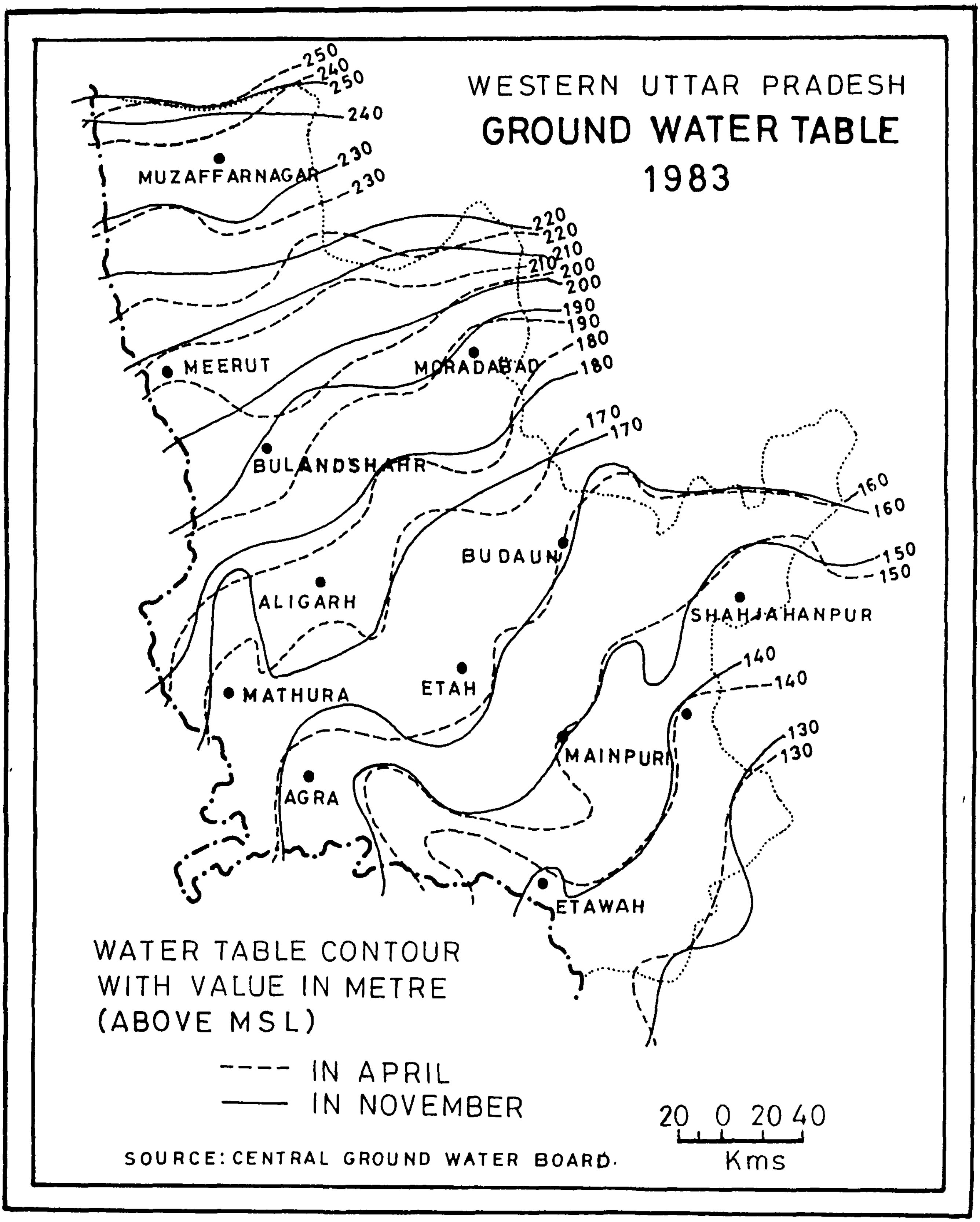
tributaries of the Ramganga are the April, Kadwara, Bhicha, Rapi, Dhela, Kosi, Dhando, Rajherra, Narha and the Bhagul.

2.1.0 Ground Water

Western Uttar Pradesh has a comparatively large source of ground water. The occurance and distribution of ground water depends upon the characteristics of the under ground formations. The alluvial terrain of the Ganga Plain forms one of the richest water bearing formations in the world.

Since this region has no marked surface irregularity the underground aquifers are supplemented from the rain water which sinks easily into the ground. The percolation from major rivers, their tributaries, canals, field channels, ponds and tanks also contribute to maintain ground water level.

According to latest estimates (December, 1983) the net available ground water resources of this region are of the order of 19.5 million cubic meters. Fig. 4 depicts the status of the ground water table contours (by converting the water level data to water table contours with volumes in meters above mean sea level) for the months of April and November 1983 obtained from the data collected by the Central Ground Water Board, Ministry of Irrigation and Power, Government of India. It shows that water table contours vary from 130 to 250 meters both in April and in November. A close examination reveals that the water contours vary according to geological structure, relief, drainage, edaphic and climatic conditions and follows general



WESTERN UTTAR PRADESH
GROUND WATER TABLE
1983
250
240
250
240
230
230
220
220
210
210
200
200
190
190
180
180
170
170
160
160
150
150
140
140
130
130
MUZAFFARNAGAR
MEERUT
MORADABAD
BULANDSHAHR
BUDAUN
ALIGARH
SHAHJAHANPUR
MATHURA
ETAH
MAINPURI
AGRA
ETAWAH
WATER TABLE CONTOUR
WITH VALUE IN METRE
(ABOVE MSL)
IN APRIL
IN NOVEMBER
20 0 20 40
Kms
SOURCE: CENTRAL GROUND WATER BOARD.

FIG-4

south-easterly direction corresponding to the surface slope. In the northern districts lying in the tarai belt, the water table lies within 5 meters in summer but rises up during the rainy season and immediately thereafter creates swampy conditions. In the Central Ganga Plain the water table ranges in depth from 5 to 10 meters but in the interfluvial tracts of the rivers Ganga and Yamuna it may be 15 to 20 meters deep. In the canal command areas the water table lies within 2 meters because of the influence of seepage from water channels.

CHAPTER III

CLIMATE AND SOILS

3.0 India is predominantly the land of tropical monsoon climate. It is possible to grow two or more crops in a year in most parts of the country, provided adequate soil moisture could be maintained. On account of the uniformity of relief there is a remarkable uniformity of climate over large areas of Western Uttar Pradesh. As the region lies between the dry Punjab plains and the humid eastern plains of Uttar Pradesh, it experiences the climatic characteristics of both the adjoining regions. With comparatively greater incidence of winter rain, the region distinguishes itself from eastern plain. The region recieves 60 to 100 centimeters of annual rainfall of which 90 per cent occurs during the rainy season.

From climatological point of view the year in Western Uttar Pradesh can be divided into three seasons:

1. The cold weather season (November to February)
2. The hot weather season (March to mid-June)
3. The season of general rains (mid-June to October)

3.0.1 Winter season is marked by a fall in temperature and prevalance of dry and chilly westerlies and clear skies. Occasionally the western depressions bring some well come rains and a cold wave when temperature may come down to freezing point. The maximum temperature falls from about 29^{O}C to 23^{O}C while minimum falls from about 12^{O}C to 10^{O}C in December (Fig.5).

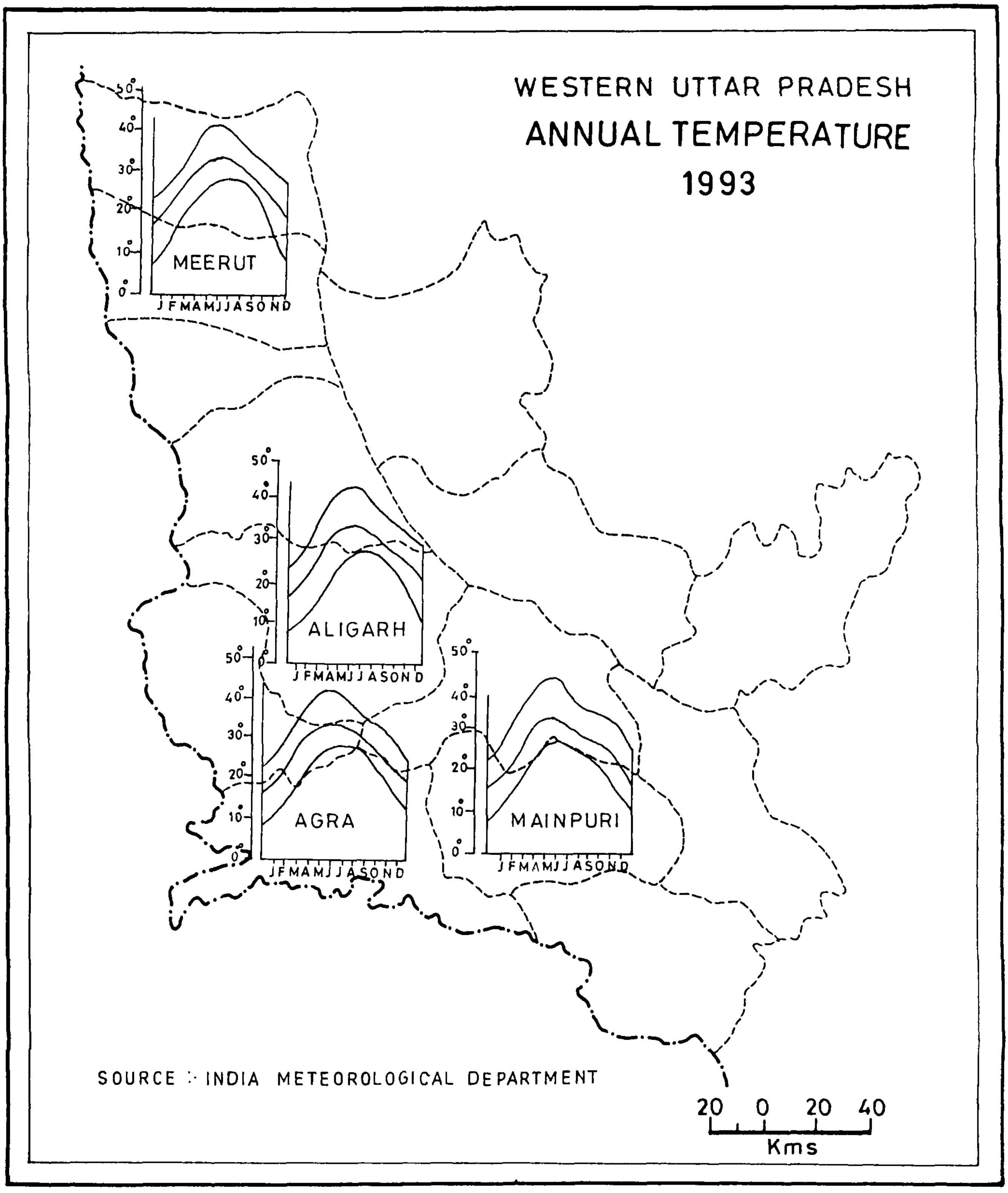

WESTERN UTTAR PRADESH
ANNUAL TEMPERATURE
1993
MEERUT
ALIGARH
AGRA
MAINPURI
J F M A M J J A S O N D
0° 10° 20° 30° 40° 50°
SOURCE :- INDIA METEOROLOGICAL DEPARTMENT
20 0 20 40
Kms

FIG-5

The temperature shows a further decrease in January when the maximum and minimum are 21°C and 6°C. The cold waves coming from the Himalayas also bring a fall in the temperature for a short period. The direction of prevailing winds is normally from west and north-west to east and south-east. The winds are dry and light and generally blow at an average speed of about 3.2 Kilometers per hour. During the winter season specially in the months of January and February, a series of western depressions enter India through Iran, Afghanistan and Pakistan and move eastward across the Western Uttar Pradesh. These depressions cause cloudy weather and light rain accompanied by cold waves[1].

The total rains occuring during winter season does not exceed from 4 to 5 centimeters. The precipitation decreases from west to east. The winter rains are not sufficient for rabi crops especially for the high yielding varieties of wheat which requires 5 to 6 irrigations. Under these conditions irrigation is a must for carrying successful agricultural operations. Proper irrigation also saves the crops from the loss caused by the frost. The frost, which occurs in this region during winter season is harmful for the crops like arhar, peas and mustard.

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1. **Gilbert, J.Walker and Roi Bahadur, Hun Rej,** "The Cold Weather Storms of Northern India", Memoirs of Indian Metrological Department, Vol.XXI, pant VII, 1901, pp.16-19

3.0.2 The hot weather period extends over the months of March, April, May and the first week of June. The rise of temperature in March and clear skies with light westerly winds of the day and relatively cool nights produce good effect on the ripening of the rabi crops. The temperature rises even more in the months of April and May. Similarly, the mean maximum and minimum teperatures also increase from west to east. The maximum and minimum temperature for April are 38°C and 21°C. In April the days are usually hot while nights remain still cool. The mean monthly relative humidity decreases to considerable extent. The months of May and June record exceptionally high temperature as high as 44°C and even more than 46°C for a few days. In hot season winds blow from west, north-west to east, south-east. In the months of May and June the hot winds known as loo originate as a result of the convective air movement produced by the heating of the surface air and rapid decrease of temperature as one goes up in the atmosphere[2]. Dust and thunderstorms locally known as andhis usually occur in the afternoons and are accompanied by squally winds, thunder, blinding dust and sometimes rains.

3.0.3 The season of general rains commences from the second week of June and continues upto October. On account of

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2. **Blandford, H.F.,** "Hot winds of North India", Memoires of Indian Metrological Department, Vol. V, No.6, 1886, Calcutta, pp.162-95

excessive heat, a low pressure develops in northern part of India and by the middle of June it brings a complete reversal in the air movements. The winds begin to move from the Indian Ocean to the landmass in a south easterly direction. These humid oceanic currents bring heavy downpoures which reduce the temperature of the area. The sudden arrival of monsoons transforms the whole landscape. July and August are the rainiest months of the year and about 55 per cent of the total annual rainfall occurs during these months. The average rainfall is about 75 centimeters and the amount decreases westwards as well as southwards. The maximum and minimum temperature gradually falls from 44^{o}C to 27^{o}C in June to about 30^{o}C and 25^{o}C in July. The relative humidity remains over 70 per cent throughout the rainy season. Fig.6 shows the variation in rainfall. A variability in excess of 20 per cent implies great risk in farming. In these areas therefore agriculture cannot be carried without irrigation.

3.1 SOILS

Generally the soils are so uniform and similar in their characteristics that it is often difficult to differentiate the soil of one region from that of the other. However, the soils of Western Uttar Pradesh are of alluvial origin. These soils have resulted from the deposition of the silt brought by the rivers and tributaries of the Ganga system. The alluvium has been divided into the broad geological

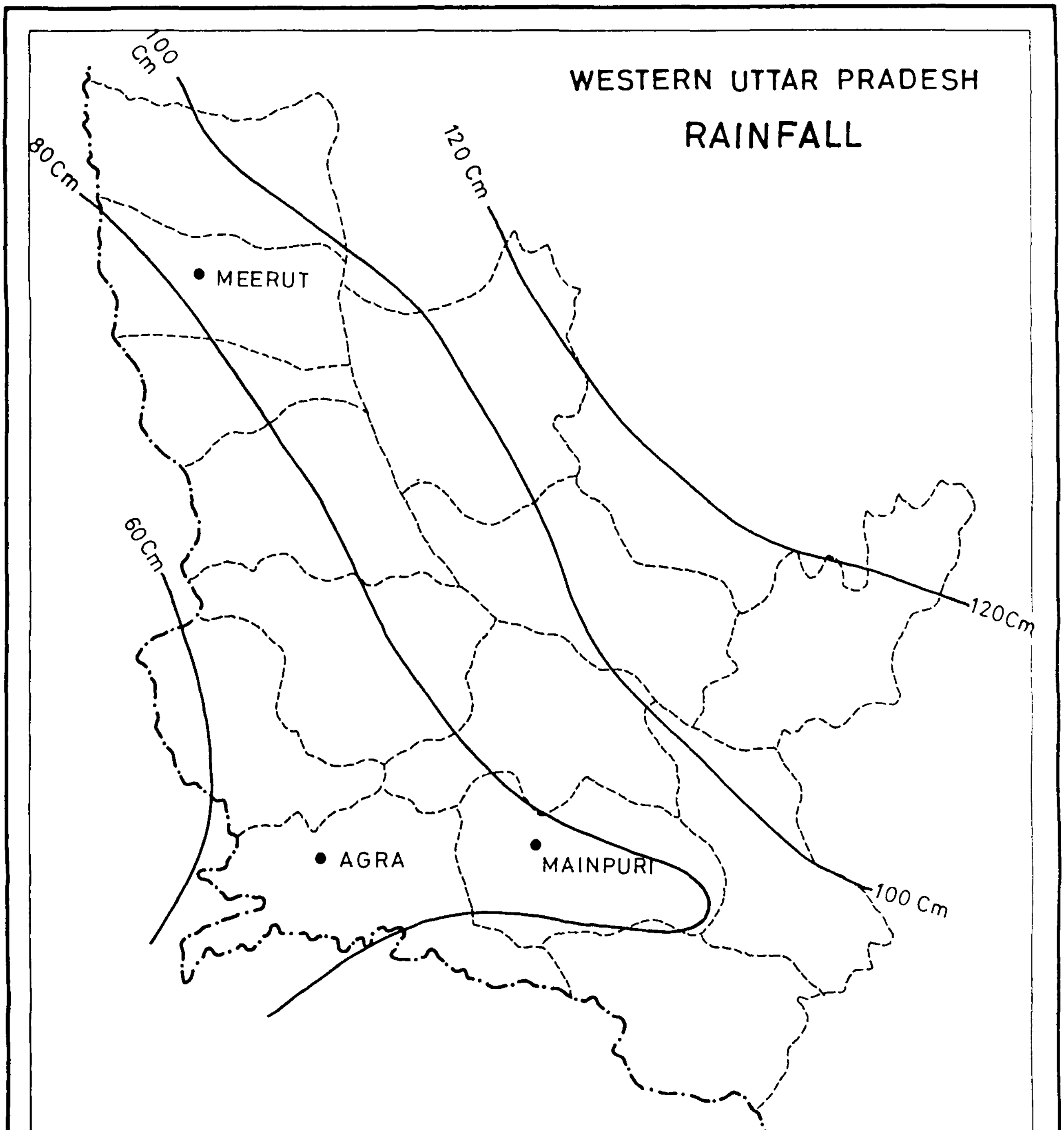

WESTERN UTTAR PRADESH
RAINFALL
100 Cm
80 Cm
120 Cm
60 Cm
MEERUT
AGRA
MAINPURI
120 Cm
100 Cm
SOURCE : INDIA METEOROLOGICAL DEPARTMENT
20 0 20 40
Kms

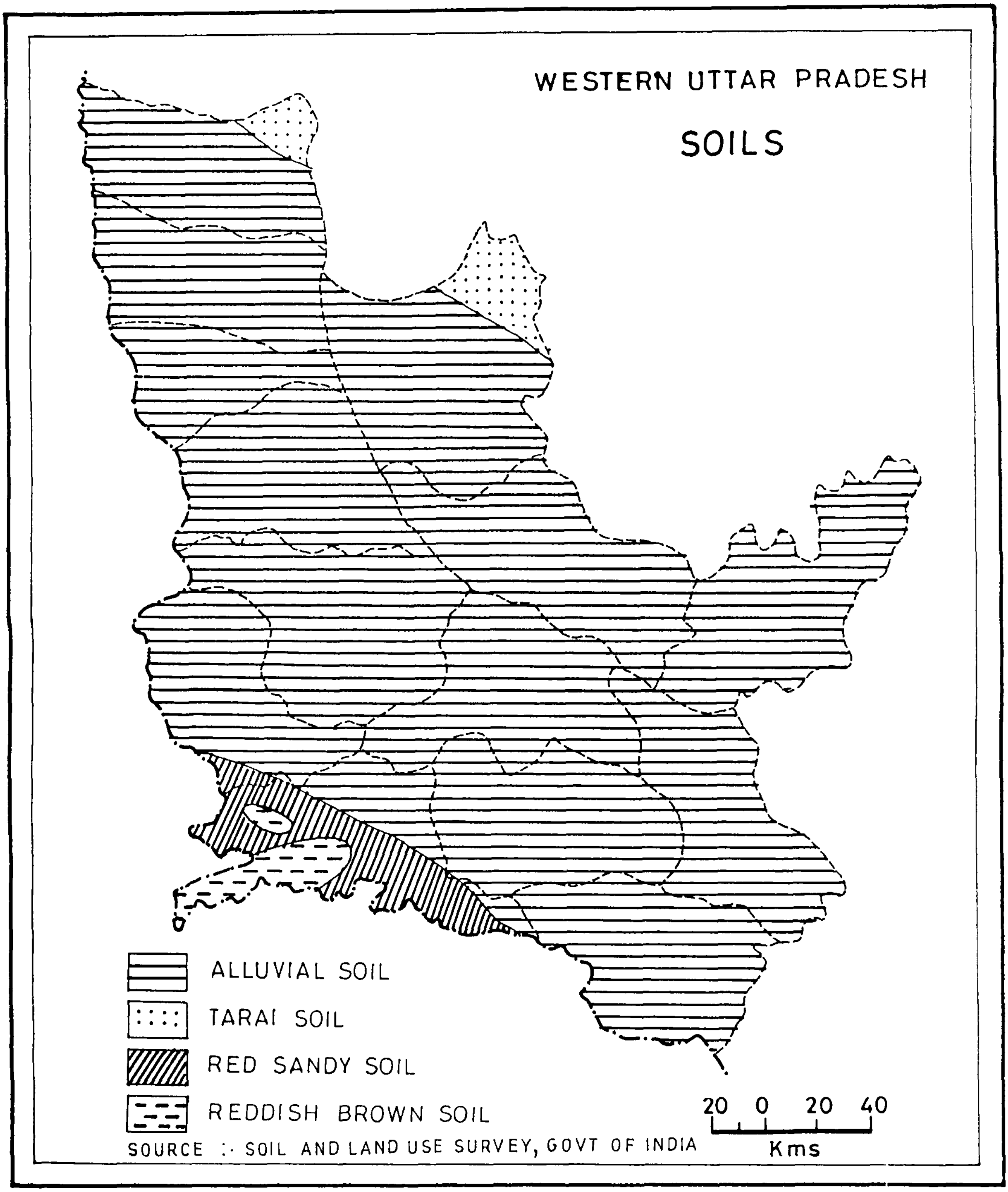
FIG-6

subdivisions, i.e. old alluvium and new alluvium. The newer alluvium of sandy nature, of less Kankari composition and light in colour is known as Khadar. It is in the process of building up. The older alluvium of more clayey composition, full of Kankar and of darker in colour is called bhangar. It is in the process od denudation. The Khadar occupies the flood plains of the rivers and their tributaries as a result of which the constituents of such lands are renewed every year. The bhangar soils are represented by level plains above the flood level of the rivers and the tributaries. These soils differ considerably in their texture and range from sandy bhur through loam and silt to heavy clay which are ill-drained and sometimes charged with injurious salts resulting into the formation of reh.

Broadly speaking, the soils of Western Uttar Pradesh can be divided into three groups: (1) The Khadar or newer alluvium, (2) The bhangar or older alluvium and (3) The tarai. (Fig.7).

3.1.1 Khadar or new alluvial Soils

Khadar is limited in extent and strictly confined to the terraces and the flood plains of the big rivers i.e. Ganga, Yamuna and Ramganga and their tributaries. It makes a narrow strip along both sides of the main rivers and is always exposed to floods and water-logging. Its water retention capacity is very poor. The colour of the soils varies from light grey to ash grey and the texture is sandy to silty loam. The



WESTERN UTTAR PRADESH
SOILS
ALLUVIAL SOIL
TARAI SOIL
RED SANDY SOIL
REDDISH BROWN SOIL
20 0 20 40
Kms
SOURCE :- SOIL AND LAND USE SURVEY, GOVT OF INDIA

FIG.7

ground water table is usually very high and lies near the surface. The sandy soil popularly known as bhur for the most part consists of sand of whitish colour. The Khadar tract is quite precarious for agriculture. It is generally used for the production of millets and pulses in Kharif and mostly barley and gram in rabi. Salt efflorescence is quite negligable in sandy tract.

3.1.2 Bhangar or old alluvial Soils

The bhangar soils are more extensive in areal spread, occupying the interfluvial zones. The most important material in bhangar is clay which at places becomes loam or sandy loam. It generally contains Kankar and is of darkar in colour.

On the basis of texture, the bhangar soils have been further sub-divided into sandy, sandy loam, loamy, clayey, silty loam and saline and alkaline soils.

Sandy soils on bhur have an unusual geomorphic feature that adds a variety to the rather monotonous landscape. Its sandy ridges with a flat topped and gentle lateral slopes extend into the Moradabad district from northwest to southeast and are roughly parallel to river Ganga. It extends upto Budaun district only and there is no bhur area in Shahjahanpur district. It is poor in humus content. This is due to the fact that the soils has undergone several stages and degrees of oxidation.[3] It was until recently a somewhat negative tract mostly[4]. But now it has partly been reclaimed through some manuring and irrigation and is being utilized for agriculture. The chief crops grown in this tract are millets and pulses among the grain crops, groundnut among other crops of Kharif and wheat, barley and peas in the rabi.

Sandy loam soils occupy a considerable portion of a generally well drained plain. The tract comprising sandy loam stretches in elongated strips along the main rivers like Ganga and Yamuna and run just in the immediate vicinity of the Khadar lands. These long patches are well defined along the river Yamuna. The greatest width of this tract is seen in Aligarh, Agra and Mathura districts. The sandy loam tract is rather broad in the upper regions of Muzaffarnagar, Meerut, Bulandshahr and in parts of Aligarh districts. It is interspersed by long patches of good quality loam chiefly in Etah and Farrukhabad districts. The sandy loam belt in Budaun and Moradabad districts stretches along both eastern and western sides of the bhur tracts as well as the north and south of it. The most

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3. **Gerassimev, I.R.,** "Gangetic type of soils on the Teritory of India", Journal of Indian Society of Soil Sciences, Vol.VI, No.4, 1958, p. 158, and **Singh, H.P. and Chatterji, S.O.** "The Soils of Rohana Kalan zone of Muzaffarnagar district, U.P., Indian Journal of Sugarcane Research and Development, Vol.2, Pt.IV, 1958, p.151

4. **Spate, O.H.K.,** India and Pakistan, London, 1957, p.500

characteristic feature of this soil is its homogeneity and level topography throughout the area. The texture of these soils is predominantly sandy and the colour ranges from yellow through brown to reddish brown. It contains humus but lesser than loamy soils. Without irrigation and manuring the soils becomes weak in crop production. The water holding capacity is generally low. The main crops grown in this soil are millets, pulses, maize, tobacco and groundnut in Kharif and barley, peas and potato in rabi. Sugar cane can also grow where irrigation facilities are available.

Loamy soils lies in disconnected patches. It is the best soil of the region which is rich in humus and organic matter. Water retention capacity of this soil is comparatively high and the underground water level is low. These soils locally known by different names in different parts of the region are generally called as matyar, domat and Kalihar. One elongated patch of loamy soils runs more or less parallel to the Kali nadi passing through Aligarh, Etah and Farrukhabad districts. Another important tract of this soil runs through Mathura and Agra districts in Western side of the river Yamuna. Third tract runs through Moradabad and Budaun districts. It also covers a considerable area in Shahjahanpur district. The colour ranges from light grey to brownish grey. The underground water table is low. The surface soils have more of sands, shows light acidic reaction while at places where the percentage of clay increase, the reaction is mostly basic and the surface is covered with efflorescence. In many depressed areas, the percentage of clay increases towards the lower depth, with the result that Kankar pans are found in the bottom[5].

Clayey loam soils occur in lowlying areas where *jhils* and swamps are common feature and the drainage is very much restricted. One tract of this soil type is found between the Rina and Sengar nadi, another in the northwest and west of Ramganga in Budaun, Shahjahanpur and Moradabad districts. It is also found in the westernmost part of Mathura and Agra districts. The soil is darker in colour. The calcarious pans (Kankar) are also found sometimes in the sub-soil. The soil is better for transplanted rice. Millets and Kharif pulses are grown in comparatively higher and drier parts, whereas gram, peas and fodder are grown in the rabi crops.

Silty loam soil is slightly different from the loamy soil. It is more fertile. It is found dispersed in upper interfluvial plain of Ganga-Yamuna doab.

The saline and alkaline soils popularly known as *reh*, *usar* or *thur* are found scattered in vast stretches. It is generally distributed in the lowlying and ill-drained areas. More or less it is found in every district but in Aligarh, Mainpuri and Etawah, it covers vast areas (Figure 8).

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5. **Ray Chaudhri, S.A., Agarwal, R.R. and others**, *Soils of India*, Indian Council of Agricultural Research, New Delhi, 1963, pp. 385-86

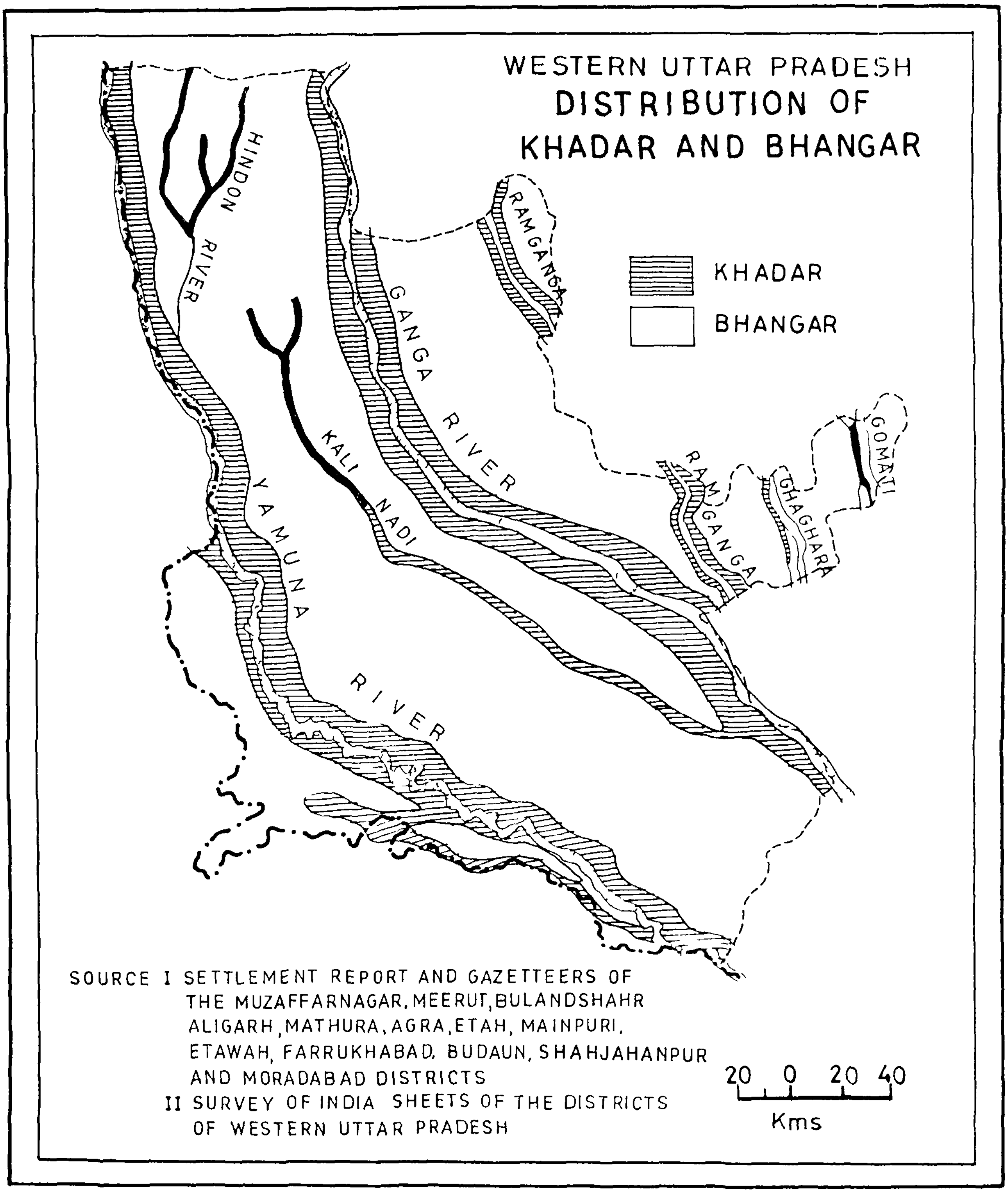
WESTERN UTTAR PRADESH
DISTRIBUTION OF
KHADAR AND BHANGAR
KHADAR
BHANGAR
HINDON RIVER
RAMGANGA
GANGA RIVER
KALI NADI
YAMUNA RIVER
RAMGANGA
GHAGHARA
GOMATI
SOURCE I SETTLEMENT REPORT AND GAZETTEERS OF THE MUZAFFARNAGAR, MEERUT, BULANDSHAHR ALIGARH, MATHURA, AGRA, ETAH, MAINPURI, ETAWAH, FARRUKHABAD, BUDAUN, SHAHJAHANPUR AND MORADABAD DISTRICTS
II SURVEY OF INDIA SHEETS OF THE DISTRICTS OF WESTERN UTTAR PRADESH
20 0 20 40
Kms

FIG. 8

3.1.3 Tarai Soils

The tarai soils cover a small area in Moradabad district. The texture varies from clay-loam to sandy-loam. Due to excellent moisture the need of irrigation is less. The surface soils are rich in organic matters as well as nitrogen content.

CHAPTER IV

AGRICULTURAL DEVELOPMENT : A Review of Literature

4.0 Agriculture has witnessed over-all development in the world since the begining of this century. Indian agriculture has also undergone change owing to governmental efforts and scientific utilization of land. The government has setup commissions and committees for the promotion of the welfare and prosperity of rural population in India, e.g. the Famine Commission, the Committee on Cooperation of 1915 and Royal Commission on Agriculture in 1926. These commissions and committees made many recomendations for the development of agriculture in India.

After independence the economists, geographers, agricultural planners and the government of India have all been concerned with agriculture and its development. According to Khare, due to certain inbuilt constraints of a backward area, development in certain parts could not be spread to the rest of the area. The agricultural development should be coordinated with dispersal process through a chain of agro-based industries and it is through such a decentralised strategy that one can achieve the balanced regional agricultural development in the country[1].

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1. **Khare, H.P.**, Yojana, Vol. 31, No.3, 1987, p.28

Shafi has given a formula both to determine the agricultural productivity and to determine the productivity of a particular crop with reference to yield per hectre and the area of that crop in the district in relation to the national level[2].

Tara Shukla pointed out certain problems of growth of traditional agriculture such as transformation of traditional agriculture, stages of increasing agricultural production,spread *of new technology and bases of technological research*[3].

The optimum use of land for production as pointed out by Shafi depends to a large extent on the level of technology and the system of farming. In his opinion, there are two ways for increasing food production: a) increasing the area under cultivation, and b) increasing the output per head. He also points out that one of the major hinderance in the optimal use of the land lies in the land tenure system[4].

According to Chawdhari, the farmers, in order to produce more, need to spend more on improved inputs which must be financed either out of savings or borrowing[5].

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2. **Shafi, M.,** "measurement of Agricultural Productivity of Great Indian Plains", The Geographer, 1972,Vol.19, No.1, pp.4-13

3. **Shukla, T.,** Economics of Underdeveloped Agriculture, Bombay, 1969, p.1

4. **Shafi, M.,** "Increasing our Agricultural Production", The Geographer, Vol.28, No.1, 1981, pp.1-8

5. **Chawdhari, T.P.S.,** Crop Loan System, Hyderabad, 1970, pp.1-8

Noor Mohammad has emphasised the use of modern *technology for bringing* about a change in agricultural output. He pointed out that the technological factors such as fertilizers, improved seeds, pesticides and new farm implements are capable of increasing the agricultural productivity[6]. In view of Oammen, the term technological change means all kinds of innovations and inventions which are aimed at increasing the efficiency of agricultural productivity[7].

The point which needs immediate attention according to Noor Mohammad is that the gestation period between the first thought technological change and putting it into practice even at low level of intensity should be reduced. Therefore, for increasing production and bringing about a remarkable result immediately after the introduction of an innovation, specific methods have to be taken to bring down this period[8].

Minhas and Nathan have explained the inter-state and intra-state variations in output in terms of variations in

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6. **Mohammad, N.,** "Technological change and Diffusion of Agricultural Innovations", Perspectives in Agricultural Geography, New Delhi, Vol.4, 1981, pp.267-271

7. **Oammen, M.A.,** "Technological *change and its Diffusion in* Agriculture-Is Existing Institutional Setup Adequate", Agricultural Situation in India, Vol.21, No.7, 1966, p.523

8. **Mohammad, N.,** "Technological change and its Diffusion of Agricultural Innovations", The Geographer, Vol.23, No.1, 1976, pp.4-14

the extent of variable culturable area and per hectre yield[9].

Bhalla has concluded that the variation in the agricultural productivity is introduced mainly by the nature of various inputs of technology[10].

According to Kanwar, for a maximum output from land it is necessary to bring more land under irrigation, fertilizers, high-yielding varities and better agronomic technology[11]. The application of technology in agriculture as suggested by Thirumalai should be geared in a way to get immediate and long term gains. The development programmes based on technology are related to the conservation of soil resources, expansion of irrigation facilities, intensive farming through the application of modern techniques, manures, fertilizers and high-yielding varieties of seeds[12].

In the present days what is needed to improve agriculture in all parts of the country is to conduct area-wise

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9. **Minhas, B.S. and Nathan, V.,** "Growth of Crop Output in India 1951-54 to 1958-61", Indian Journal of Agricultural Economics, Vol.17, 1965, pp.230-47

10. **Bhalla, S.,** Agricultural Growth- Role of Institution and Infra-Structure Factors, Economic and Political Weekly, Vol.12, No.45, 1977, p.1898

11. **Kanwar, J.S.,** "Fertilizer- The Kingpin in Agriculture", Indian Farming, Vol.18, No.12, 1969

12. **Thirumalai, S.** Post-war Agricultural Problems and Politics in India, Bombay, 1954

study of the cultivators problems and evolve technology to meet specifically the problems and constraints causing low productivity in each region (Bhatia)[13]. It is because of technological innovations that the world agriculture is able to feed world's population today. The innovations came one after another in stages. At every stage, the adoption of new technique meant a great leap forward towards increase in agricultural production.

According to Pal, the irrigation alone cannot increase the required agricultural production. It is the other inputs also used with adequate water supply which can increase the agricultural production[14].

The immediate outcome of the green revolution was in the form of increased agricultural production but in view of Arshad, it has failed to make any appreciable difference in the overall rate of agricultural growth. According to him, the introduction of high-yielding varities along with new technology and fertilizers alone cannot balance agricultural production. An all-round production and growth in all the crops in all the regions is the only solution[15].

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13. **Bhatia, B.M.,** Poverty, Agriculture and Economic Growth, Kanpur, 1977, p.136

14. **Pal, B.P.,** "New Planning for Water Management Research", Indian Farming, Vol.17, No.10, 1968

15. **Arshad, M.,** "Has Green Revolution made any Impact", Yojana, Vol.30, No.23, 1986, p.11

Sharma has suggested that the development of agriculture should be assessed not only by productivity levels but also with reference to inputs such as fertilizers, improved varieties of seeds and irrigation[16].

The correct use of fertilizers has been pointed out by Koakab Durry as an important step towards increasing agricultural efficiency. This can be achieved not only just by going along with general recommendations but by accertaining the actual nutrient deficiencies of the soil that have to be taken care of by applying the appropriate quantities of nitrogen, phosphorous and potash[17].

The policies of increasing the fertilizer use as suggested by Desai should be based upon a strategy which aims at both rapidly converting the untapped potential into actual use and continuously raising the economic potential of fertilizer use through upward shifts in response functions. It has been seen that fertilizer diffusion has been most rapid on crops and varieties which respond to fertilizer use dramatically, even though they did not have best price environment[18].

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16. **Sharma, A.C.,** Mechanization of Punjab Agriculture, New Delhi, 1976

17. **Durry, K.,** "Improving Agricultural Efficiency through Fertilizers", The Geographer, Vol.33, No.2, 1986, pp.13-24

18. **Desai, M.,** "Policies for Growth in Fertilizer Consumption: The Next Stage", Economic and Political Weekly, May 1986, pp.428-33

According to Jaine Quizon, fertilizer is the crucial input in raising the agricultural productivity. It is because of its importance that the government intervention in the fertilizer market to encourage its more widespread production and use has been a common phenomema[19].

As the availability of fertilizer is limited, Arora and Sharma have proposed to increase area under pulses or other non-fertilizer using crops, where as high-yielding varieties of wheat and paddy may be raised under irrigated conditions[20].

Jain concludes that agriculture is now paying well on account of the availability of a wide array of high-yielding varieties of seeds and hybrid seeds. If, institutional finances are made available to the farmers, they can purchase all these costly inputs and agricultural productivity can be increased[21].

Burney advocates the use of pure seed as one of the cheapest input and one of the most recognised facts about

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19. **Quizon, J.**, "Withdrawal of Fertilizer Subsidies: An Economic Apprasial", Economic and Political Weekly, Vol.20, No.39, September, 1985, pp.A 117-A 123

20. **Arora, V.P.S. and Sharma, J.S.**, "Optimal Allocation of Fertilizer Nutrients among Different Regions of Uttar Pradesh and the Impact on Cropping Pattern and Production Levels", Agricultural Situation in India, Vol.36, No.1, 1981, p.7

21. **Jain, S.C.**, Management in Agricultural Finance, Bombay, 1970, p.3

the agricultural development[22]. Shastry has carried out a detailed assesment of the two latest high-yielding varieties of rice: Jaya and Padma[23].

Rege pointed out the relationship between soil, water and plant and suggested use of irrigation to get assured crop especially during drought[24].

It is now widely recognized that in plans for agricultural regeneration in India, irrigation has to play a catalyst role. Bhatia feels that the use of the fertilizers and high-yielding varieties of seeds requires assured water supply to the farms[25].

The irrigation development and improved water management are crucial to India's agricultural development. The supply of land being inelastic, acclerated growth in production is possible only through increased multiple cropping and realization of higher crop yields per unit area, both of which are heavily dependent on irrigation[26].

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22. **Burney, S.M.H.,** "The Indian Seed Act Assures Quality Seeds to the Farmers", Indian Farming, Vol.20, No.5, 1970

23. **Shastry, S.V.S.,** "New High-Yielding Varities of Rice- Jaya and Padma", Indian Farming, Vol.18, No.11, 1969

24. **Rege, N.D.,** "Water Management- A New Concept in Agricultural Planning", Indian Farming, Vol.23, No.11, 1969

25. **Bhatia, B.M.,** Economic structure of Indian Agriculture, Bombay, 1984, p.436

26. **Roy, S.,** "Irrigation Development under India's New Plan (1978-83)- An Appraisal", Agricultural Situation in India, Vol.34, No.5, August, 1979, pp.303-308

The ground water has already proved itself to be the most valuable source of water in the country for irrigation purposes. According to Vohra state ground water organisations must be responsible for giving competent technical advice to farmers regarding the kind of tube-wells and pumpsets the farmers should install in their holdings so that there is no wastage of either scarce materials and scarce energy resources. The state governments should also take up systematic programmes for the consolidation of holdings because this is one of the surest ways of encouraging ground water development[27]. Vasant suggests that efficient management of the developed water resources and supply and application of all other inputs needed for irrigated agriculture can produce sufficient foodgrain for the over increasing population of India[28].

The importance of water management for increasing yields has also been highlighted by Destance and Patil[29].

The farm benefits from a unit of irrigated area are not consonant with the size of a farm holding. Small farmers can gain, acre for acre, as much benefits from irrigation as do large farmers. Therefore, Dhawan suggested a policy of extensive irrigated agriculture in which lightly irrigated crops would

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27. **Vohra, B.B.**, "Managing Ground Water Efficiency", Yojana, Vol.31, No.4, March 1978, pp.19-20

28. **Vasant, N.S.**, "Development of Irrigation and Power in India", Yojana, Vol.31, No.6, April 1987, p.20

29. **Destance, N.G. and Patil, V.S.**, "Water need of Crops", Indian Farming, Vol.17, No.10, 1968

preponderate to be more attractive from several larger angles such as agricultural growth, its stability and interpersonal/ spatial equity within the state[30].

The cultural machinery and implements as pointed out by Bater can raise the agricultural productivity and it was therefore suggested that machinery and implements should be introduced in areas where they are not used[31].

The food and Agriculture Organisation has published two reports in 1953 and 1955. The report published in 1953 emphasised on machinery and stated that the machinery is more cheaper than labour. The second report published in 1955 gives an idea of progress in technology for agriculture. Another report published in 1968 deals with the problem of raising agricultural productivity by applying modern technology[32]. Jain also concluded that mechanization is highly responsible for raising the agricultural productivity[33].

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30. **Dhawan, B.D.,** "Irrigation Impact on Farm Economy", Economic and Political Weekly, Vol.20, No.39, 1985, pp.A 124-A 128

31. **Bater, W.N.,** Mechanization of Tropical Agriculture, London, 1957

32. **F.A.O.,** The State of Food and Agriculture, Rome, 1953, 1955, 1968

33. ***Jain, S.C.,*** Technological Changes and their Diffusion in Agriculture, in S.C.Jain (ed.) Changing Indian Agriculture, Bombay, 1966, pp.57-58

In studies relating to pests, Mathur has revealed that the use of high yielding varieties and seed treatment with organomercury compound is an important step towards the control of a number of seed borne diseases[34]. According to Pradhan, there are 62 pest species which are common to several crops and are causing damage to agricultural production[35].

Increasing the agricultural production is a must and their protection from pests according to Singh is as important as use of irrigation, high-yielding varieties and fertilizers. He has suggested that the farmers need to be educated about judicious use of fertilizers otherwise the boon can turn into bane[36].

According to Khanna and Mital, there are about 85 species of insect-pests, reducing the yield of rice in Uttar Pradesh[37].

In a recent study made in Utar Pradesh the key question was raised as to how the increase in agricultural productivity is dependent on variables like irrigation by canal,

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34. **Mathur, R.S.,** Plant Disease, New York, 1969

35. **Pradhan, S.,** Insect-Pest of Crop, New Delhi, 1969

36. **Singh, R.P.,** "Plant Protection- A Must", Yojana, Vol.28, No.11, 1984, p.27

37. **Khanna, S.S. and Mital, V.K.,** "Pest of Paddy and their Control in U.P.", Indian Farming, Vol.20, No.4, 1970

tubewell and from other sources, high-yielding varieties of seeds, fertilizers per 1000 hectares and tractors per 1000 hectares. Shafi pointed out that for optimum utilization of land resources, the programmes of land reform, consolidation of fragmented holdings, irrigation and drainage should be integrated and executed in proper sequence[38].

A recently published F.A.O. report emphasised the role of land system in the development of agriculture[39].

The two reports of United Nations in (1951) pointed out that there are four objectives of land reforms namely, maximization of output and productivity, increasing employment opportunities, fair and equal distribution of income and ethical order. The second report of the same year hase suggested certain measures to improve the agrarian system[40].

According to Raza, the output of food per head can be raised out by increasing the yield or productivity per acre. This can be achieved through carrying out necessary land reforms. He pointed out that there are strong reasons to support

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38. **Shafi, M.**, "Increasing our Agricultural Production", The geographer, vol.28, No.1, January, 1981, pp.1-8

39. **U.N.** Economic Bulletin for Asia and Far East, Vol.8, No.3, 1957, p.73

40. **F.A.O.**, Progress in Land Reform, New York, 1951, pp.51-80

the view that there has been some casual link between the land reform and agricultural productivity[41].

According to Russell King, three motives, the political, the social and the economic are basic and govern most reforms. By fixing of 20 acre ceiling on land ownership would correspond to an egaliterian motive of enabling every farming household in India to have a minimum subsistence plot of 2 acres, but the creation of million of 2 acre plots would adversely affect food production and reduce the marketable surplus[42].

Singh and Mishra, after making a survey of land reforms in Uttar Pradesh suggested certain changes for increasing the area under cultivation including current fallow by more than 8 per cent[43].

The most important feature of backwardness of Indian agriculture as pointed out by Jather and Beri is the endless subdivision and fragmentation of holdings. In the light of their occurrence the authors have suggested remedial measures to control this problem[44].

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41. **Raza, M.,** "Land Reform and Land Use in U.P." The Geographer, Vol.15, 1968, pp.39-49

42. **King, R.,** Land Reform; A world Survey, London 1977, p.3

43. **Singh, B. and Mishra, S.,** A Study of Land Reforms in Uttar Pradesh, Calcutta, 1964

44. **Jather, G.B. and Berims, G.,** Indian Farming, Madras, 1949

Report of National Commission on Agriculture (1976) pointed out that one of the major causes of low agricultural productivity in India is the fragmentation of holdings. It suggests the consolidation of holdings as the only answer to improve the agrarian structures[45].

However, there has been some concern about the fragmentation of holdings and according to Jather and Beri, the areas previously uncultivated due to excessive fragmentation have now been brought under cultivation through land consolidation[46].

Manu has studied the scope for land consolidiation and conservation and their impact on agricultural productivity, while Saxena and Sharma have focussed attention on the causes of soil erosion and various methods to control them. These methods have been applied in Etawah district in Utar Pradesh[47].

Agricultural credit, according to Thirumalai is the pivotal problem in the scheme of agricultural development in India. Credit is the motive power for setting on its wheels the productive machinery in agriculture conceived and planned on

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45. **Report of the National Commission on Agriculture**, Government of India, Minestry of Agriculture and Irrigation, New Delhi, 1976, part 15, p.184

46. **Jather, G.B. and Beri, S.G.,** Indian Economics, Madras, 1949

47. **Manu, W.S.,** "Scope for Consolidation of Holdings and Soil Conservation and its Effects on Agricultural Production", Indian Journal of Agricultural Economics, Vol.14, No.33, 1959

a scientific basis[48].

Dadibhavi has conducted a micro-level study of the problems of agricultural development of backward regions and calls for urgency in rechannelising the institutional finance flows to micro-generating activities in the low per capita income regions[49].

The strategy of agricultural development in the opinion of Goud calls for extending proper financial assistance to the farmers so as to improve them from clutches of money lenders and for rapid agricultural development. He is of the view that there should be a seperate agency to finance the farmers at village level. According to him, in this connection primary agricultural cooperative credit societies play immense role in transforming the traditional agriculture into a modern one[50].

In India, the first comprehensive analysis of the whole problem of agricultural credit was made by the Committee of Direction of the All Indian Rural Credit Survey appointed by the Reserve Bank of India in August, 1951. Its report suggested three important ingredients, a) the governments concern must

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48. **Thirumalai, S.**, Post-war Agricultural Problems and Policies in India, Bombay, 1954, p.181

49. **Dadibhavi, R.V.**, "Why these inter State Disparties", Yojana, Vol.31, No.11, 1987, p.4

50. **Goud, R.S.**, "Cooperative Finance and Weaker Sections", Yojana, Vol.31, No.4, 1987, p.14

assume major resposibility for provision of funds, b) the realisation of the intimate relationship between the agricultural credit and marketing of agricultural produce, and c) the agricultural credit based on the productive capacity of the borrower is feasible and ought to replace credit based on the security of immovable property[51].

According to Sharma all agricultural productive activities require for their sustenance some degree of credit. A farmer who can raise only one crop a year, has to maintain himself and his family throughout the year, therefore, needing loan. The agricultural credit is largely responsible for the agricultural development[52].

A study published by Union Ministry of Cooperatives and Panchayati Raj shows the importance of cooperative in the development of agriculture providing loans and other important inputs. Cooperatives ensure the full share of all the farming comunity through balanced growth of production[53].

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51. **Chawdhari, T.P.S.,** Crop Loan System, Hyderabad, 1970, pp.1-8

52. **Sharma, A.N.,** Economic Structure of Indian Agriculture, Bombay, 1984, p.247

53. **Kumaraswamy, S.,** "Expanding Role of Cooperative in Agriculture", Agricultural Situation in India, Vol.24, No.3, 1969

It has been suggested by Nath that the development of cooperatives and expansion of infrastructure will help in the development of Indian Agriculture[54].

The Congress Agrarian Reform Committee pointed out that unless and until land is owned by tiller his incentive to production does not reach the optimum point due to his being insecure about the benifits from the land that he cultivates. Even if he is allowed to enjoy the security of tenure, will only enhance the rate of rent which he has to pay, if the improvement in land is made by him[55].

Drawbacks of the prevailing land system are highlighted by Singh and Mishra who say that often it inhibit all initiation, stifles all efforts and prevent any enlargement of inputs due to insecurity, rack-renting, the practice of subletting and feudal or feudalistic structure of land rights[56].

Agricultural development throughout the world is strongly motivated by the incentive of the farmers, which may take the form of pride and ownership, security of occupancy and expectation of a just division of farm income between landlords

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54. **Nath, V.**, "Agricultural Growth in 1970's", Economic and Politican Weekly, Vol.5, No.52, pp.134-44

55. **Report of the Congress Agrarian Reforms Committee**, p.38

56. **Singh, B. and Mishra**, A Study of Land Reforms in Uttar Pradesh, p.10

and tenants. These factors everywhere have the impact in improving the conditions of land[57].

Agricultural productivity depends on two setsof factors: technological and institutional. Those who advocate technological factors are of the view that even, if no institutional reforms are introduced, technological improvements will bring about agricultural development. On the other hand, another school of thought strongly believes that agricultural development is seriously hampered on account of certain institutional barriers. They argue that indroduction of institutional reforms can release agriculture from the bondages which keep it backward and depressed. The existence of feudal or semi-feudal land relations are the biggest obstacle to agricultural development. The bulk of the income of the poor cultivators is appropriated by the land owners in the form of rent, share cropping, etc and the peasants are left with very little savings to bring improvements in land. Moreover, insecurity of tenancy rights as a further disincentive for undertaking investments in hand. In times of natural calamities like floods or droughts, the poor peasants are forced to borrow from the landlords or moneylenders. Being debtors, they are forced to sell their crops to the agriculturist moneylenders at prices much below the market prices. Thus, the institutional

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57. **U.N. Economic Bulletin for Asia and Far East**, Vol.11, No.1, June, 1960, p.8

framework of ownership, tenancy and agricultural credit all work in such a fashion that they deny the cultivators the fruits of his effort[58]. The exploiting classes represented by the landlord, the agriculturist, money-lenders and mechanics exploit the actual tiller of the soil. It is therefore believed that in order to reap full benefits of technological change, institutional reforms are extremely necessary.

4.1 TECHNOLOGICAL FACTORS

Technological change is one of the important forces which alter the structure of agricultural production process. The term technological change is used in a broad sense to include all kinds of inventions and innovations aimed at increasing the efficiency of agricultural production. Technological change is the key to rapid rate of growth in Indian agriculture that lies in continuous economic adjustment of town organizations to absorb technological improvements on a profitable basis. The proper combination of various technological factors i.e., ensured agricultural innovations, use of chemical fertilizers, high yielding varieties of seeds, modern agricultural machinery and improved farming techniques should enhance agricultural efficiency and yield much returns.

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58. **Dutt, Ruddar,** Evaluation of the Indian Economy, New Delhi, 1986, p.234

The technological factors throughout the history of mankind in general and during the recent years in particular have played significant role not only in over-comming various environmental constraints on agriculture but also in bringing further changes and development in existing ones. A number of methods have been developed to increase productivity by using fertilizers, better techniques of working the soil, improved breedings, development of high yielding seeds, and the control of pests and diseases through the development and manufacture of pesticides, fungicides and herbicides. In brief, the technological change in agriculture consists of adoption of new farming techniques developed through research to bring out diversification and increase in production and greater economic return to farmers. High agricultural production greatly depends on the use of fertilizers, and new agricultural implements. The speedy and extensive development of agriculture, by and large, depends on technological change and spatial diffusion of agricultural innovations.

4.1.1 Fertilizers

The provision of sufficient fertilizers at resonable costs and at requisite time is the most fundamental requirement for the development of agriculture under the conditions prevailing in India. In fact the level of fertilizer use per hectare of cultivated land is closely linked to the level of crop production per hectare. The scope for increasing production by bringing more land under the plough, particularly in developing countries like India, is extremely limited and the only hope for the future lies in increasing the production per unit area[59]. Fortunately, the experience with high yielding varieties of seeds has given us confidence and the scope for increasing production by breeding and utilising fertilizer responsible for it is very large.

Fertilizers are often regarded as substitutes for animal manure, but that is not correct. Animal manure improve soil conditions and supply nutrients. Animal excreta and green manure contribute directly to the soil organic matter. Fertilizers do so indirectly by increasing the quantity of crop residues available for incorporation into the ploughed lands[60]. Nitrogen, phosphorus and potassium are required by the plant in large and are known as primary nutrients; while calcium, magnesium and sulphur are secondry nutrients. The requirement of these nutrients is generally supplied by the use of common nitrogen, phosphorus and potassium fertilizers.

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59. **Champa, M.,** "Agricultural Development and the Role of Fertilizers", Indian Journal of Regional Science, Vol.8, No.1, 1976, p.151

60. **Ignatieff, V.,** Efficient use of Fertilizers, F.A.O., Agricultural Studies, Italy, No.43, 1958, p.2

The quantity of fertilizers to be applied to each crop depends upon the level of the nutrients in the soil and the crop requirements. Lack of nitrogen results in poor growth of plant, and a uniform yellowing of the leaves. Indian soils are deficient mainly in nitrogen. The source from which the required nitrogen can be used are farmyard manure like cowdung, compositing of night soil and vegetable refuse, etc, oil cake, green manure like Saun and dhencha, bonemeal and chemical fertilizers. The most beneficial method whereby this essential element of nitrogen can be applied is through the roots of leguminous plants carrying out a natural process of nitrogen fixation[61]. Lack of phosphate is often associated with a purple leaf colour, particularly at the edges, but in certain crops such as cotton and tobacco the leaves become dark green. Insufficient potash causes a swelling of the leaf edges of many plants including tobacco, cotton, maize, groundnuts and many fruit trees. The effect of potash on sugarcane varies with the soil and rainfall. The sugar content of the cane is frequently increased by the use of potash.

Thus an important step towards increasing the efficiency of agriculture is to ensure the correct use of fertilizers and this can be done not only by just going

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61. **Durry, Koakab,** "Improving Agricultural Efficiency through Fertilizers", The Geographer, Vol.23, No.2, July 1986

alongwith general recommendations but by ascertaining the actual nutrient deficiencies of the soil that have to be taken care of by applying the appropriate quantities of nitrogen, phosphorus and potash. In, fact, fertilizers and manures constitute a crucial input in agricultural production[62].

4.1.2 High Yielding Varieties of Seeds

Almost every cultivator knows the potentiality of high yielding varieties of seeds for raising the level of return from the crop. The country has attained self-sufficiency in seeds of high yielding varieties and is in position even to export these seeds to other countries. The HYVs of crops offer an unprecedented opportunity for a breakthrough in agricultural productivity. If used with suitable combinations with other inputs in particular, fertilizers, water and crop protection chemicals, they are capable under favourable conditions of raising yields severalfolds compared with those of local varieties. The new varieties may be superior to the old ones in three different ways; yield capacity, cultural reliability, and quality of product[63].

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62. **Thirumalsi, S.,** Technology in Agriculture Development, Postwar Agricultural Problems and Policies in India, Bombay, 1954, p.169

63. **Smaller Farmlands can Yield More**: Raising Agricultural Productivity by Technological Change, F.A.O., United Nations, Rome 1969, p.14

The phenomena of any improved variety must be considered in relation to a given ecological and agricultural environment. The yield potential of the new cereal varieties can be achieved only if they are used in conjection with adequate inputs of fertilizers and water, careful attention of crop production and generally high standards of farming.

In 1960-61, a pilot project in seven intensive Area Delelopment Programme (IADP) districts was tried. These areas were such which had an assured supply of irrigation and were free from natural hazards. The project decided to introduce high yielding varieties with recomended dose of chemical fertilizers. The IADP districts showed 25.53 per cent higher yield per acre than the non-IADP districts. In some cases, the difference of yield was of the order of 50 per cent.

For most traditional varieties of wheat and rice, fertilizer responses fall off at about 40 to 50 Kg of nitrogen per hectare. For high yielding varieties, the response increases upto 100 Kg or more. In India, recomended fertilizer doses for the Mexican wheat are 80 to 120 Kg N, 40 to 60 Kg P_2O_5 and about 40 Kg K_2O per hectare[64]. In 1966-67, two purely Mexican varieties of wheat seed named Larna and Sonara-64 were adopted for cultivation in irrigated areas. About 1800 million tonnes of high yielding varieties of wheat seed were imported from Mexico

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64. **Ibid.**, p.17

which faciliated the cultivation over large area in India at that time, there was great doubt about the wisdom of importing such large quantities of seeds. Later on, some of these Mexican varieties were improved upon by Indian scientists and new Indian varieties like Kalyan Sona, Sonalika, Safed Larna, Chhoti Larna have been evolved. Water availability and management are particularly important. Mexican varieties of wheat should receive at least two or more irrigations than the local ones. In some areas of rice fields the problem is an excess rather than a deficiency of water. For example, because of deep flooding the new short-strawed varieties cannot be introduced without improved water control. Pests and diseases are another problem.

So the application of the package of inputs of high yielding varieties and recomended doses of fertilizers have resulted in increase in yield per hectre[65]. However, in such crops where distinctly superior high yielding varieties were available, the rise in yields has been spectacular. This is clearly noticed in the wheat revolution in Punjab, Harayana, Rajasthan and Western Uttar Pradesh. The new Mexican varieties like Lerma Rojo, Sonara-64, Kalyan and P.V.-18 became so popular that the government was unable to meet the demand of farmers for better seeds and it also could not supply adequate quantities of fertilizers against the rapidly rising demand. However, some

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65. **Dutt, Ruddar,** op. cit., p.242

breakthrough has been achieved in rice areas. Better high yielding varieties are being developed in rice and other areas.

The art of plant breeding, reinforced by the science of genetics, has revealed possibilities of increasing yield of crops, through new varieties, sometimes based on hybrid vigour. It is essential that normally five to ten years is the time required for placing the entire area of a crop under improved varieties in most of the areas through organised multiplication and distribution of seeds[66].

4.1.3 Irrigation

Alongwith good seeds and fertilizers, there is also the need for timely supply of water in adequate quantities. In India, farmers are most dependent on rainfall for the supply of water to their fields. But monsoons are highly uncertain and irregular. The capriciousness of rainfall in India manifests itself in a variety of ways. In any particular year, the rains may not arrive at all, or it may come in torrents. Again, the monsoons may start too early or too late, or yet again the rains may not be sufficiently prolonged and well distributed. All this upsets agricultural work, resulting in partial or complete failure of crops. And the tragedy is that the uncertainties or

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66. **Thirumalai, S.,** op. cit. p.171

abnormalities of rainfall in India are the general rule, rather than the exception. As such the harm caused by them is a normal feature of Indian agriculture. Therefore, irrigation can afford security against the vagaries of monsoon[67].

The most effective way of increasing agricultural production in India is to control the sources of water supply and increase the maximum possible limit of irrigational facilities to provide assured, adequate and regular water to the fields throughout the crop-calender year, according to the needs of the crop pattern that may be determined as necessary to fulfil the objective of increase in production[68].

Because of unfavourable rainfall, farmers could cultivate only one crop without irrigation in the limited period. Therefore, irrigation development and improved water management are crucial to India's agricultural development. The supply of land being inelastic, acclerated growth in production is possible only through increased multiple cropping and realization of higher crop yields per unit area, both of which are heavily dependent on irrigation[69].

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67. **Agrawal ,A.N.,** Indian Agriculture and its problems, Delhi, 1953, p.14

68. **Thirumalai, S.,** Post-war Agricultural Problems and Policies in India, Bombay, 1953, p.60

69. **Roy, Shyamal,** "Irrigation Development under India's New Plan (1978-84)- An Apprasial", Agricultural Situation in India, Vol.26, No.5, August, 1979, p.303

It has recently been suggested that India can be divided into three broad groups of areas according to the character of the water supply and the stability of production and that different policies are required for each of these areas. The first area lies where there is an assured water supply both in volume and in spread either from assured rainfall or from sources of irrigation, e.g. tube-wells, deep bore wells, canals from snowfed rivers or storage dams which are not unduly dependent on the vagaries of the monsoon[70]. In these areas the irrigation policy should be intensive and productivity oriented, aiming to maximize yiels per hectare. In the second group areas, where the water supply is largely dependent on the monsoon, the policy should be mainly protective. In the third group of areas, where, there is no dependable irrigation, policy should be on contour bunding and contour cropping, so as to maximize returns per unit of water.

During the first decade of planning (1950-51 and 1960-61), the main emphasis was on extention of irrigation so that more land could be brought under cultivation and better crops could be substituted for inferior crops. It is well established fact that the agricultural development lies in the extension of irrigation. Once this basic input, i.e. water, was

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70. **Sen, S.R.**, "Growth and Instability in Indian Agriculture", Agricultural Situation in India, Vol.21, 1967, p.831

made available, production would increase because other inputs such as better seeds and fertilizer could be more effectively applied. The main sources of irrigation in India are (a) canals (b) local streams, ponds and tanks and (c) wells.

Extension in the irrigation facilities and bringing more area under irrigation has its own importance in increasing agricultural productivity but farmers can get much by increasing yields on land already irrigated. Increasing yields on land already irrigated, contribute to maximizing the returns from costs that have already been incurred.

For getting the maximum benefit from irrigation, a planned system of irrigation has to take into account: a) the supply of necessary water to the crops in season, b) the damage and disposal of excess water, c) prevention of flood damages, d) conservation or stocking of water for release in dry season, e) conservation of soil in higher elevations and f) the prevention of erosion by sea in coastal tracts.

Bringing new land under irrigation is usually both time consuming and costly. Although the reason for low utilization of water resources available in India, mainly is the technical difficulties. The Command Area Development Programme (CADP) was introduced during Fifth Plan period. The programme envisages development of irrigation by the construction of field channels and access roads, land levelling and land shaping, introduction of the rotational water supply system and promulgation of integrated crop-soil-water management practices. The programme stresses to equitable distribution of water to small and marginal farmers.

A number of analytical studies have proved that India can increase its agricultural production to a large extent, if adequate and assured irrigation facilities are available[71].

Much of the disparity among the productivity permormance of the three sources is found to be due to the intersource differences in crop pattern. As one moves from tanks to canals, and onto dugwells and tubewells, the irrigated crop pattern shifts more and more in favour of rice crop that otherwise attracts a large chunk of irrigated acreage once farmers get access to irrigation facility. Productivity of groundwater irrigated land has risen much faster than that of surface irrigated lands mainly due to the fact that high yielding varieties technology has been biased in favour of farmers having access to private means of irrigation.

Irrigation is indeed the surest way in which agricultural production can be increased. Irrigation would not only include the major schemes specifically planned for bringing in the possibility agricultural production in arid regions but

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71. **Mohammad, N.,** "Technological Change and spatial Diffusion of Agricultural Innovations", Perspectives in Agricultural Geography, New Delhi, Vol.5, 1981, pp. 317-18

also schemes to ensure the supply additional water in all regions which are dependent on rainfall. On the basis of studies made in India, one acre of good irrigated farmland at the current level of technology is able to support one person[72].

4.1.4 Mechanization

Mechanization means the introduction of tools, implements and machines which substitute human labour and animal labour. For instance, the use of a tractor in place of the plough is one example which acts as a substitute for both *bullock power and human labour. There is power which is used to* draw underground water for purposes of cultivation and similarly, there are sowing and threshing machines. There are harvestors which enable the speeding reaping of the crop. So the whole range of machines and appliances which can be used from ploughing to harvesting are covered by the term mechanization[73].

Mechanization is a most conspicuous weapon that can revolutionise Indian agriculture. The electric power and diesal play significant role in the development of agriculture especially in the mechanization and rationalization of farm operation. The modernization of agriculture, through the process of mechanization, has played a very significant part in bringing

72. **Shafi, M.,** "Increasing our Agricultural Production", The Geographer, Vol.28, No.1, January, 1981, p.1

73. **Dutt, R.,** op. cit. p.245

prosperity to cultivators by ensuring them better crops at reduced costs. Its part has been equally great in the reclamation of the new land, covering wastes and barren lands into flourishing agricultural colonies.

Indian agriculture in the past has been inefficient not because of the farmers but because of the nature and society. The system of agriculture followed by farmers is the result of farming techniques or practices achieved through ages and in many places the system attained a very high standard e.g., the cultivation of rice in deltas. The Royal Commission on Agriculture of India (1928) has pointed out two opinions[74].

1. The ploughs are light which bullocks can draw and farmer can carry it on his shoulder to and from his often scattered fields.
2. Deep ploughing is essential for some crops but it may not pay the cultivators in all kharif conditions. On the contrary, it may lead to loss of moisture in the areas of light rainfall and in areas of heavy rainfall, in either case jeopardizing germination.

However, there is a great scope for improvement in tools used by farmers, e.g. seed drills, cheap threshing and winnowing appliances, better water lifts etc. Great economy could be effected by improving the bullock carts by replacing the solid wooden wheels by rubber tyres. The weight of the cart is ridiculously large compared with its capacity.

The use of tractors is increasing in India. A tractor, unlike a bullock, does not derive its motive power from the produce of the soil. As such its use will lighten on land and release a certain area for the growing of food crops. Tractor makes it possible for a farmer to do his field and farmyard operations well in time. But the efficiency of a tractor decreases where, there is small size of holdings[75].

In the beginning of course, tractors were essentially built for very large holdings. But now the position has considerably changed. The manufactures of agricultural machinery have persistently, and with success, explored the possibility of making small tractors and other machines suitable for work on small holdings. Now small, all purpose tractors of very low horse-power are available. They have been espicially designed to meet the economic and technical needs of lower acreages.

The agricultural operations can be performed much more quickly by the use of machinery than by human or animal labour. The importance of speed as a factor in agricultural efficiency is not to be minimized. Where as, for instance, an unfavourable change in the weather frequently follows harvesting time, speedy harvesting, threashing and storing of the crops may save it from much damage. The margin of the time during which

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75. **Agarwal, A.N.**, op. cit. p.124

the various operations for the preparation of the soil and for sowing must be performed may also be narrow, for each agricultural operation must be adjusted to changing weather and moisture in the soil and delay may spoil the growth of crops. For India, where weather conditions are so uncertain, machines have a special sigrificance. Mechanization of agriculture will help in stepping up the economy to the higher level[76].

Nobody can ignore the importance of mechanical irrigation in the determination of agricultural efficiency. Mechanical irrigation will not only provide adequate water to our fields at the proper time but will also help, besides generating power, in the solution of different problems connected with control of flood water, soil erosion, afforestation, etc. Modern agricultural machines are very powerful tools which can bring great benefit by appropriate and timely use. Mechanization has increased the yield of crops, in cases by permitting more timely preperation of the ground,seeding, cultivation and harvesting[77].

4.1.5 Pesticides and Fungicides

Crop pests, insects and diseases play havoc with crops and are a constant source of worry to farmers everywhere. In India, their depredations destroy as much as one-tenth of the

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76. **Ibid,** p.126

77. **Salmon, S.C. and Hanson, A.A.,** The Principles and Practices of Agricultural Research, London, 1964, pp.41-42

total production. Crops and the cropping pattern and the variable climatic conditions provide an ideal environment for the multiplication and thriving of insects, disease organisms and weeds. Therefore, there is a continuous activity of pests, diseases and weeds throughout the year posing a perennial threat to agriculture[78]. The analysis of various pesticides is done by several institutions including the Central Food Technological Research Institute, Mysore and the Indian Agricultural Research Institute, New Delhi. About 250 pesticides are used in agriculture, of which a hundred are insecticides, 50 herbicides, 50 fungicides, 20 nemacides and 20 other chemicals. Dichlorodiphenyltrichloroethane has improved the economic, social and health status of developing countries[79].

Agricultural scientists are trying their best to raise more food to satisfy the needs of an ever increasing population. The task of increasing food production has many problems, one of the most important is the control of pests and weeds[80].

Insects and pests are the most important groups of

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78. **Reddy, D.B.,** Plant Protection in India, 1968, p.2

79. **Science Reporter**, C.S.I.R. Publication, New Delhi, May, 1980, pp.316-320

80. **Rao, V.P.,** "Biological Control of Insect, Pest and Weeds", Everyman's Science, Vol.6, No.2, 1971, p.90

organisms which damage and cause loss to agriculture. These insects and pests also cause many diseases to the plants. The animal pests largely belong to insects but crabs, snails, earthworms, monkeys, hares and rabits can also be pests. There are other large animals such as jackal, deers, tortoise, blue bulls or 'neel gai' and sambar who also destroy the crops[81].

Fungi are the second most important group of organism affecting crop production. They are microscopic in size except a few species which can be seen with a naked eye. Fungi obtain their nourishment from their hosts, either living or dead. Parasitic fungi are the ones which causes diseases in plants. Fungi respond sharply to climatic conditions and often the environment determines the severity and the extent of the spread of fungus diseases. The fungi are the dissiminated through wind, water, soil, plant materials, insects and man and animals[82].

A large number of weeds both monocots and dicots infest agricultural lands and depress yields considerably. Some like 'kans' and water hyacinth have occupied thousands of hectares of cultivable land. The parasitic flowering plants limit the production of certain crops. A weed is a plant which grows in places where it is not wanted. The weeds compete with

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81. **Kumar, L.S.S. and others,** Agriculture in India, Bombay, 1963, Vol.2, p. 192

82. **Reddy, D.B.,** op., cit., p.11

crop plants and fruit trees for nutrition, moisture, light, space, etc and affect the growth and reduce or supress yields considerably. There are large number of weeds which grow in the fields, orchards and gardens and effectively reduce the yields.

Among the control measures used for containing insects, diseases and pests and weeds for preventing or limiting their damage and reduction in yields, mechanical and physical, cultural, biological and legal methods of control have played a very significant role. Cultural practices such as crop rotation, mixed cropping, adjustment in date of sowing, depth of sowing and field sanitation through removal of diseased debris and weeds play a great part in the control of plant diseases. A virus diseases cannot be prevented or cured by chemicals, the use of disease free seed goes a long way in reducing rejection. For this it is necessary to establish disease free nurseries at isolated places where rigorous roging eliminates all diseased material[83].

The use of chemical for controlling the diseases and pests are widespread in the world today. The chemical method of control is the onlyone which achieves immediate results and is most feasible under the existing farming conditions.

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83. **Handbook of Agriculture,** Indian Council of Agricultural Research, New Delhi, 1961, p.366

4.2 INSTITUTIONAL FACTORS

Rapid growth of agriculture lies in continuous economic adjustment of farm organisation by absorbing improved technological innovations and institutional cooperation on a profitable basis. The process of agricultural development has already begun and the recently introduced institutional reforms are paving way for a largescale application of modern technology. The efficiency of institutional and technological factors is appealing only when the land and people are in proper condition. A simple word 'land reform' is used to increase the productive efficiency of land.

In the traditional and generally accepted sense of the term, land reform means the improvement of agricultural institutions, for example, agricultural land, or income from land and also agricultural credit producing market[84].

Land reforms in India are intended to achieve two objectives. From the point of view of social justice, land reforms aim at redistributing ownership of land and improving in terms of land conditions of tenancy so that the share of the actual tiller of the soil improves in the value added in agriculture. In other words, the purpose of land reforms is to end exploitation of tenants, small peasants, marginal farmers and share croppers by the landlords. The second aim of the land

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84 **U.N.**, Progress in Land Reforms, New York, 1954, p.6

reform is to recognise the unit of cultivation so that holdings become economic and there is no waste of labour and capital in cultivation.

The factors which are considered for the study are land consolidation, credit supply, role of cooperative societies, land holdings, land tenure and land revenue and size of holdings. These factors play an important role in raising the agricultural productivity

4.2.1 Land Holdings

One of the important factors responsible for the backwardness of Indian agriculture is the very small size of holdings. This is accompanied by the fact that these small holdings are scattered into small fragments. The average size of holding in India is 2.3 hectares.

Obviously, the average size of holdings in India is low as compared with advanced countries of the world. There are two reasons for this: firstly, the land man ratio is not favourable in India. In other words, as compared with the amount of land available, the population of India is quite high. Secondly the proportion of population dependent on agriculture *is about 70 per cent of the total population.*

The endless sub-division and fragmentation of holdings is one of the many causes responsible for the slow growth of agriculture in India. The process of sub-division and fragmentation is not of recent origin but its history can be treated back even before Hindu period. The Hindu and Muslim laws of inheritence also accentuated this tendency as they conferred equal rights to property among the heirs.

The fragmentation and scatteredness of land holdings is one of the main obstacles in increasing agricultural production in plains as well as on hills.

Due to small size of holdings, recommended improved methods of farming cannot be adopted which otherwise would have brought higher output.

4.2.2 Land Consolidation

One of the major causes of low agricultural productivity in India is the fragmentation of holdings. It involves two processes of sub-division and fragmentation. Once the process of fragmentation begins, it is accentuated with each succeeding generation. In other words, excessive fragmentation is the result of influence of the social structure that creates too great a demand for the limited area of land by population largely dependent on it. This is due to the system of private law and custom which encouraged progressive sub-division. Land consolidation in its broadest sense always plays an important role in any programme of increasing agricultural productivity. Consolidation of holdings is today of major interest in India, which is engaged in efforts to improve its agrarian structure .

Land consolidation has been considered as the best measure to face the evil of sub-division and fragmentation. The

Planning Commission of India is also of the same view and has suggested that the programmes of consolidation of holdings should be followed with full vigour by all the states in India. Land consolidation is a process of substituting the fields of the farmers in any area in such a way as to make the holdings held by each of them more compact[85]. Land consolidation may also be defined as the amalgamation and redistribution of feilds constituting individual holdings so as to reduce the number of fragments in the holdings[86]. Consolidation of holdings has been regarded as an aspect of an integrated programme of village reconstruction and besides regrouping of fragmented holdings included connected work of land improvement[87]. Consolidation of holdings aims at giving every farmer a compact area equivalent in value, and as far as possible in area to the area held by him previously.

Land consolidation not only facilitates cultivation but also reduces the cost of cultivation.

The cooperative consolidation of holdings, legislation for compulsory consolidation of holdings was passed in 1928. The Government of Uttar Pradesh passed land

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85. **Sharma, A.N.**, Economic Structure of Indian Agriculture, Bombay, 1984, p.136

86. **Agrawal, G.D. and Bansal, P.C.**, Economic problems and Indian Agriculture, Delhi, 1969, p.141

87. **Tiwari, S.N.**, "Land Consolidation and its Impact on Land Utilization", The Deccan Geographer, Vol.8, No.1&2, 1970, p.89

consolidation Act in 1909. The provision of the Uttar Pradesh Act came into force in January 1940 and the scheme of consolidation was introduced in 12 districts. The consolidation Act of Uttar Pradesh was amended in 1958 in order to accelerate the pace of consolidation by removing the obstacles which cause delay in this work.

Consolidation of holdings has a number of advantages. It saves both time and labour, supervision and management of land become easy and efficient operational efficiency is promoted. There is much greater scope for irrigation and conservation practices. Consolidation of holdings provides an opportunity for replanning the entire village commumity. It encourages adoption of modern farming practices.

The consolidation of holdings will have direct effect on the productivity of land. Agricultural operations are carried out on the entire area of the holding at the most favourable time.

In brief, a correct procedure in colsolidation ensures the allotment of fields to the farmer on the basis of variations in soil, topography, location etc., to enable him to grow the major crops of the area.

4.2.3 Effect of Consolidation of Holdings on Cultivation

Consolidation of holdings effects the cultivation in many ways are as follows:

a) Increase of agricultural efficiency.

b) Development of soil condition.

c) Development in the extension of cultivation.

d) Better management.

e) Increase in social condition.

When the land is compact in a single plot the cultivator has to devote his full time in it. In this way this scheme saves the time, labour and energy and has helped the cultivators to be quick and careful to supervise their fields. With consolidation of holdings, the cultivation becomes easier and it also reduces the cost of cultivation. The land which is wasted in boundaries, farms etc., can be brought under cultivation by land consolidation and thus the cultivation can be increased.

By the land consolidation, the soil condition can also be improved. When the land is consolidated, the manure can be conserved and more intensive cultivation is possible. It is observed that the acreage in irrigated lands has increased after consolidation. The scheme of land consolidation has brought a great change in the attitude and tendency of peasants in cultivation of crops. Because of good irrigation facilities, the cultivation of many crops has comparatively increased. Recommended and improved methods of cultivation can be adopted which would have brought higher output by the land consolidation. The scheme of land consolidation effects the social structure very much.

4.2.4 Credit Supply

Rapid growth in agricultural production in the short run requires a rapid and radical change in the use of agricultural technology which is reflected in the use of high yielding varieties of seeds, intensive use of fertilizers and plant protection measures. The new technology is highly productive but at the same time, more costly and unless proper credit facilities in conjunction with careful extension advice and other necessary institutional infrastructure are provided to a majority of cultivators, no substantial gains can be achieved. Agricultural credit in terms of crop loans is a variable resource and is meant for meeting the costs of some of these critical costly inputs apart from providing sustanance to the farm family during the period preceding the harvest.

Credit supply is one of the most important economic determinants and life blood for agricultural development. In order to produce more, farmers need to spend more on improved inputs which must be financed either out of savings or by borrowing.

It is said that if adequate and timely credit supply is provided to the farmers with lower interest rate, they can develop their agriculture more quickly. Availability of adequate and timely credit facilities promote fast development of agriculture[88].

There are institutions like cooperative societies, Land Development Banks, Commercial Banks, Regional Rural Banks and National Bank for Agriculture and Rural Development which play an important role in agricultural development. Banks like commercial banks make credit available in the form of advances for the distribution of fertilizers and other inputs. In this way, Indian farmers are raising agricultural production by timely credit supply. So with the help of such credit, use of fertilizers, improved seeds, adoption of plant protection measures etc., may certainly be promoted.

4.2.5 Cooperative Society

Cooperative credit societies are the most important source of credit to the farmers. Primary agricultural credit societies provide short term, medium term and long term loans to the farmers for productive purposes.

Efforts to build-up institutional financing for agriculture started with the adoption of the Cooperative Credit Societies Act in 1904. Later on the All India Rural Credit Survey (1951-54) pointed out that in spite of various administrative reforms and availability of credit from Reserve Bank of India the cooperative system accounted for 3 per cent of the total borrowing of the cultivators and farmers continued to

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88. **Mohammad, N.,** op. cit. pp.223-24

depend on money lenders. It suggested establishment of large size societies with increased State assistance. The National Development Council (1958) recommended that the cooperatives should be organized on the basis of village community. It should also be remembered that the central need of the small and marginal farmers is not merely money but the timely availability of a package of inputs.

Now a days cooperative societies are the main source of loans for agricultural activities. Farmers got urgent and immediate financial help through cooperatives.

The main characteristic of cooperative is that it provides for effective use of loans through efficient supervision. Now the cooperatives are the best remedies in respect of agricultural marketing.

In the field of agriculture, cooperative societies provide various inputs which play a crucial role in the agricultural development. Cooperatives provide chemical fertilizers, high yielding varieties of seeds, new implements and machinery, irrigation facilities, pesticides and spraying equipments.

The Agricultural Cooperative Credit Societies have become a very important source of short term and medium term credit. They are slowly replacing the money lenders in the villages.

The purpose of the short loan is to purchase seeds, fertilizers, cattle, etc. In times of famines, such loans are also used to support families. These loans are for a period of less than 15 months and are generally repaid after the harvest.

Medium term loans are for a period ranging between 15 months to 5 years. They are mostly used to purchase agricultural implements, to make improvements on land, etc. The purpose of these loans is to enable the cultivator to purchase relatively more costly equipment and spread the repayment over a period of 5 years.

Long term loans are for a period of more than 5 years. These loans are used to buy land, to pay off old ancestral debt, to purchase costly agricultural machinery like a tractor or a harvestor.

4.2.6 Land Tenure and Land Revenue

One of the various factors that contribute to the well being or otherwise of the agricultural industry, the system of land tenure is by far the most important. The term "land tenure" stands for the system of rights and obligations of the members of the rural community in relation to the landlord and state[89]. It refers to the terms or conditions upon which land is held or possessed; it defines the legal relation in which the

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89. **Agrawal, A.N.,** op. cit., p.150

holder of any land stands to the government or any other superior landlord. In brief, the system of land tenure relates to the question of intermediary interests, land utilization and distribution of farm income.

Obviously that system of land tenure is ideal which provides for maximum utilization of land in the general interest of the community, most efficient cultivation and progressive farming, fair distribution of farm income, opening up of opportunities for a further development of peasants personality and peace and social progress in the countryside. The cultivator will have the incentive to produce more and better only when he enjoys security of tenure and is assured of fair return for his labour. At the same time, the system should be so designed as to promote the well-being of the whole man and to subserve desirable social ends. For the past few years various State Governments in our country have been carrying out land reforms in their respective territories with a few to make agriculture efficient and progressive and also to create new social values.

From very ancient times the state in India claimed a share of the produce of the soil from the cultivation. The institutes of Timur represented the first systematic attempt in the direction of commuting the state's share of the produce into money. The next attempt was made by Sher Shah (1940-45). During his times the whole territory was measured and neetly divided into Suba's, which were sub-divided into Sarkar's and then into Dastoor and Pargana's from where revenue was collected. The third and most famous settlement was made under Akbar. A more scientific and detailed system of investigation into taxable capacity of different soils was undertaken as a necessary preliminary to the fixation of the revenue demand. Land was carefully measured and divided into four classes representing different grades of fertility. The share of government fixed at one third of the gross produce. Option to pay in cash based on the average prices of foodgrains during 19 years preceding the settlement was given, and the term of settlement was fixed at nine years. Mugals are credited with the introduction of regular records and revenue accounts for the purpose of gaining definite knowledge about the financial resources of the state.

The next important feature of the history of land revenue and tenure is the appearance of revenue farming, a factor of great sifnificance in the development of local system of the land tenure in more than one province. The institution was designed to ensure a steady flow of income into the treasure of the Central Government which in the declining days of Mugal Empire became more incapable of controlling the revenue offícals in the outlying parts of the empire. The system became fairly general in Bengal from the reign of Emperor Farukhsiyer (1813-17). Under it the farmer paid to the government nine-tenth of the whole collection and kept the rest as his remuneration.

With the introduction of British rule in the country, the state was regarded as the supreme landlord. The British fixed the maximum demand at one half of the net assets. The agrarian society of the British period was so structured as to impede the development of forces of production. During British rule, three kirds of land tenure was established. These were a) Zamindari, b) Ryotwari, and c) Mahalwari.

According to the Zamindari system, ownership rights were conferred on one or several Zamindars for a certain piece of land. Land revenue was either fixed in perpetuity or for a shorter period ranging between 20 and 40 years. Under the Ryotwari system, the peasant himself was the owner. The land revenue has to be paid by the owner of the land. Land revenue was fixed for 20 to 30 years. Under the Mahalwari system, lands were jointly held by the village communities. For the payment of land revenue, the village community was jointly responsible. Lumbardars collected the land revenue and received 5 per cent commission for depositing it in the state treasury.

Uttar Pradesh under the British rule was temporary settled Zamindari province. Land under the personal cultivation of the Zamindars was called Sir and Khudkasht. Next to Zamindars, there were sub-properietors and under-properietors.

The Uttar Pradesh Zamindari Abolition Committee (1944-45) estimated that one in every five cultivators was a tenant under a tenant, a tenant of Sir and Khudkasht of occupier of land without consent. All of them have little security of tenure and could be evicted from the land by the landlord. These inferior tenure holders cultivated no less than 8.87 per cent of the total area.

Zamindari was abolished in the State with effect from July 1952 and the multiplicity of tenures was reduced to only three categories, viz., Bhumidari, Sirdari and Asami and the cultivator was brought into direct contact with the state.

The most important feature of the post-Zamindari abolition period was a marked increase in the area under cultivation and current fallow. The area under old fallow and cultivable waste decreased considerably. "Graveyards and otherwise barren land" also showed a decline of about 20 per cent[90].

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90. **Singh, B. and Mishra, S.,** A Study of Land Reforms in Uttar Pradesh, p.167

PART - II
TECHNOLOGICAL AND INSTITUTIONAL FACTORS, AGRICULTURAL PRODUCTIVITY AND AGRICULTURAL DEVELOPMENT: AN ANALYTICAL ASSESSMENT

CHPATER V

TECHNOLOGICAL AND INSTITUTIONAL FACTORS: SPREAD AND DIFUSSION

The process of agricultural development is achieved out through constant improvement in mechanical implements, fertilizers, irrigation and pesticides. The innovation in agricultural operations are possible with the help of the private institutions and the government machineries. The technological change and spatial diffusion of agricultural innovations mainly depends on economic conditions, size of farm, irrigation facilities and literacy standard of the farmers. It reveals that better the economic condition of the farmer, larger will be the technological change as he is capable to withstand the loss if any. Similarly the farmers who have larger fields, starts the use of fertilizers earlier and give high doses as compared to the farmers having fields of smaller size.

The technological change in agriculture consists of adoption of farming techniques developed through research and calculated to bring out diversification and increase in production and greater economic return to farmers. The use of fertilizers, improved varieties of seeds, pesticides and fungicides, improved irrigation facilities, new agricultural implements and contour bunding are some of the examples of such techniques. Needless to mention in spite of such a crucial need, there is a lack of technological change and diffusion of agricultural innovations in India.

The author in the following discription has tried to discuss and assess the diffusion of various technological and institutional factors in the study region every tenth year from 1950-51 to 1990-91.

5.0 IRRIGATION

In a region like Western Uttar Pradesh where natural water is not sufficient for the use of improved seeds and chemical fertilizers, the importance of irrigation has increased.

Irrigation in Western Uttar Pradesh is provided through two different sources, firstly by channelising surface water from rivers, wells and other sources and secondly by tapping subsoil water through wells, tube-wells and pumps. The main source of irrigation in the region are canals, tube-wells and other sources like wells and tanks. Table I show the net irrigated area as a percentage from total cropped area in the agricultural season, total irrigated area as percentage from the gross cropped area in the year and the total irrigated area as a percentage from the gross cropped area in the year and the total irrigated area as a percentage of all the three different sources of irrigation in Western Uttar Pradesh. All the districts have been assigned high, medium and low grades in terms of irrigation availability. The districts having more than 60 percent of the total cropped area under irrigation fall under

TABLE I

Percent of irrigated area by different sources of Western Uttar Pradesh: 1950-51

Districts	Net Irrigated Area *	Total Irrigated Area **	Irrigated Area by Canals ***	Irrigated Area by Tube-wells ***	Irrigated Area by other sources ***
Muzaffarnagar	56.30	51.00	70.14	-	29.85
Meerut	65.40	61.40	56.67	-	43.32
Ghaziabad	-	-	-	-	-
Bulandshahr	64.20	58.10	44.27	-	55.72
Aligarh	61.90	54.70	42.54	-	57.45
Mathura	49.50	48.00	78.76	-	21.23
Agra	32.10	31.10	51.90	-	48.09
Mainpuri	53.10	46.50	47.38	-	52.61
Etah	47.20	41.80	48.11	-	51.88
Badaun	19.00	17.70	-	-	100.00
Shahjahanpur	15.90	14.50	53.76	-	46.23
Moradabad	20.70	20.10	6.62	-	93.37
Farrukhabad	29.40	27.60	36.64	-	63.65
Etawah	36.30	33.50	83.22	-	16.77

Source : Statistical Bulletin of Uttar Pradesh (1950-51), Directorate of Agriculture, Lucknow, U.P.

Note:

* - Percentage of net irrigated area from net cropped area.

** - Percentage of total irrigated area from total cropped area.

*** - Percentage of irrigated area by canals/tube-wells/other sourc from net irrigated area.

high grade, those have an irrigated area between 30-60 percent of the total cropped area are considered as of medium grade while those districts which have less than 30 per cent of the total cropped area under irrigation are placed under low grade in terms of irrigation. The changes in area under irrigation by the three sources have been studied every tenth year to find the gradual development of irrigation from 1950-51 to 1990-91.

5.0.1 Position of Irrigation in 1950-51

There are only one district namely Merrut which has high extent of irrigated area. The area with medium extent of irrigation is a large one spreading in the Ganga-Yamuna doab and in the south-eastern part of the study region and includes the districts of Muzaffarnagar, Bulandshahr, Aligarh, Mathura, Agra, Mainpuri, Etah and Etawah. Low irrigation spread is seen in the districts of Budaun, Shahjahanpur, Moradabad and Farrukhabad.

Canals

Fig.9 shows the position of irrigation by three different sources in Western Uttar Pradesh. Canal irrigation is extensive in Etawah district which irrigates more than 80 per cent area. Beside it, there are nine more districts, viz. Muzaffarnagar, Merrut, Bulandshahr, Aligarh, Mathura, Agra, Mainpuri, Etah and Shahjahanpur where canal irrigation covers 40

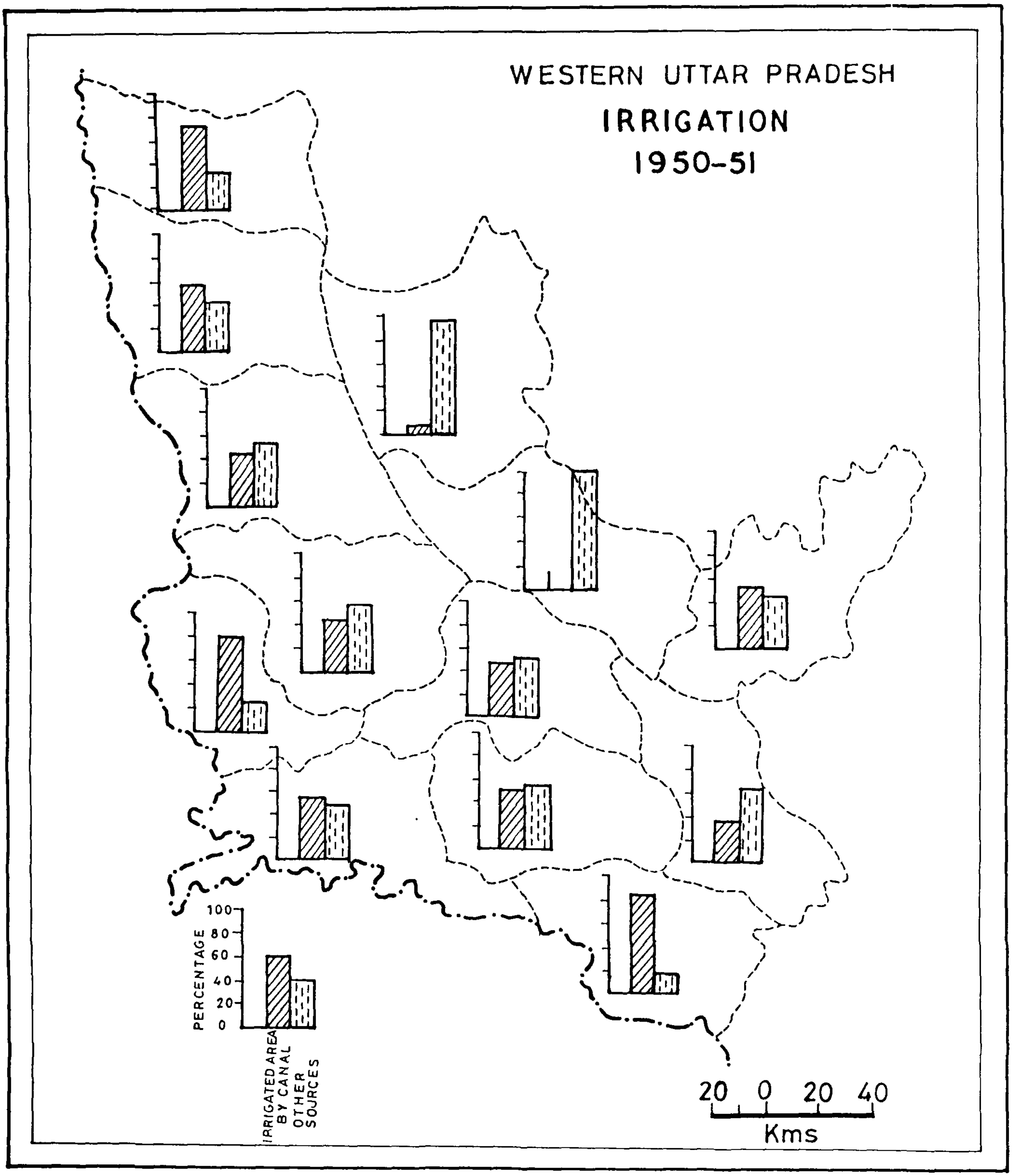

WESTERN UTTAR PRADESH
IRRIGATION
1950-51
100
80
60
40
20
0
PERCENTAGE
IRRIGATED AREA
BY CANAL
OTHER SOURCES
20 0 20 40
Kms

FIG. 9

to 80 per cent of the net irrigated area. Budaun district has no area under canal irrigation. The remaining two districts namely Moradabad and Farrukhabad have a lower share with less than 40 per cent of their net irrigated area under canal irrigation.

Tube-Wells

Irrigation by tube-wells are not in vogue during 1950-51 in the whole region.

Other Sources

The other sources of irrigation include tanks, wells and ponds. Moradabad and Budaun are the two districts depending on irrigation from other sources which commands more than 90 per cent of the net irrigated area. Next in importance are the districts of Bulandshahr, Aligarh, Agra, Mainpuri, Etah, Shahjahanpur and Farrukhabad where irrigation from other sources ranges from 45 to 90 per cent of the net irrigated area. In the remaining districts of Muzaffarnagar, Merrut, Mathura and Etawah with less than 45 per cent area of the net irrigated area is irrigated by other sources.

5.0.2 Position of irrigation in 1960-61

The Table II reveals that in 1960-61, Merrut was the only district falling in the category of high grade of irrigation availability with more than 60 per cent of the total cropped area under irrigation. The districts which show medium

TABLE II

Percent of irrigated area by different sources of Western Uttar Pradesh: 1960-61

Districts	Net Irrigated Area *	Total Irrigated Area **	Irrigated Area by Canals ***	Irrigated Area by Tube-wells ***	Irrigated Area by other sources ***
Muzaffarnagar	59.10	53.78	68.58	14.54	16.86
Meerut	68.59	63.58	53.36	19.67	26.95
Ghaziabad	-	-	-	-	-
Bulandshahr	61.23	54.35	43.12	19.41	37.13
Aligarh	53.23	44.76	42.03	19.85	38.10
Mathura	41.77	37.23	82.88	0.05	17.05
Agra	27.10	23.77	58.15	3.62	37.78
Mainpuri	36.23	29.99	50.55	9.71	39.72
Etah	40.11	33.62	48.19	12.86	38.93
Badaun	18.53	17.13	-	47.28	52.69
Shahjahanpur	9.82	8.90	57.60	11.16	31.23
Moradabad	22.32	20.19	4.65	49.72	45.61
Farrukhabad	30.23	29.11	36.38	18.49	45.11
Etawah	41.16	35.86	84.15	0.27	15.56

Source : Statistical Bulletin of Uttar Pradesh (1960-61), Directorate of Agriculture, Lucknow, U.P.

Note:

* - Percentage of net irrigated area from net cropped area.

** - Percentage of total irrigated area from total cropped area.

*** - Percentage of irrigated area by canals/tube-wells/other sources from net irrigated area.

grade of irrigation availability are Muzaffarnagar, Bulandshahr, Aligarh, Mathura, Etah and Etawah commanding 30 to 60 per cent of the total cropped area. The districts with less than 30 per cent of the total cropped area under irrigation or of low grade in terms of irrigation are Agra, Mainpuri, Budaun, Shahjahanpur, Moradabad and Farrukhabad.

Canals

It is evident from the Fig. 10 that the canal irrigation is extensive in two districts namely Mathura and Etawah where more than 80 per cent of the net irrigated area receives water through this source. Beside it, there are eight districts, viz. Muzaffarnagar, Merrut, Bulandshahr, Aligarh, Agra, Mainpuri, Etah and Shahjahanpur where canal irrigation area ranges between 40 to 80 per cent of the net irrigated area. The districts of Moradabad and Farrukhabad receive canal irrigation less than 40 per cent of the net irrigated area. Budaun district still in 1960-61 did not have any area irrigated by canal.

Tube-wells

Tube-well irrigation is of recent origin in India and the rate of its diffusion to every corner of the country has been very fast. It has changed the cropping pattern of many parts of the country which were earlier beyond the reach of irrigation water. Two districts of the region namely Budaun and Moradabad receive more than 40 per cent of their irrigation from

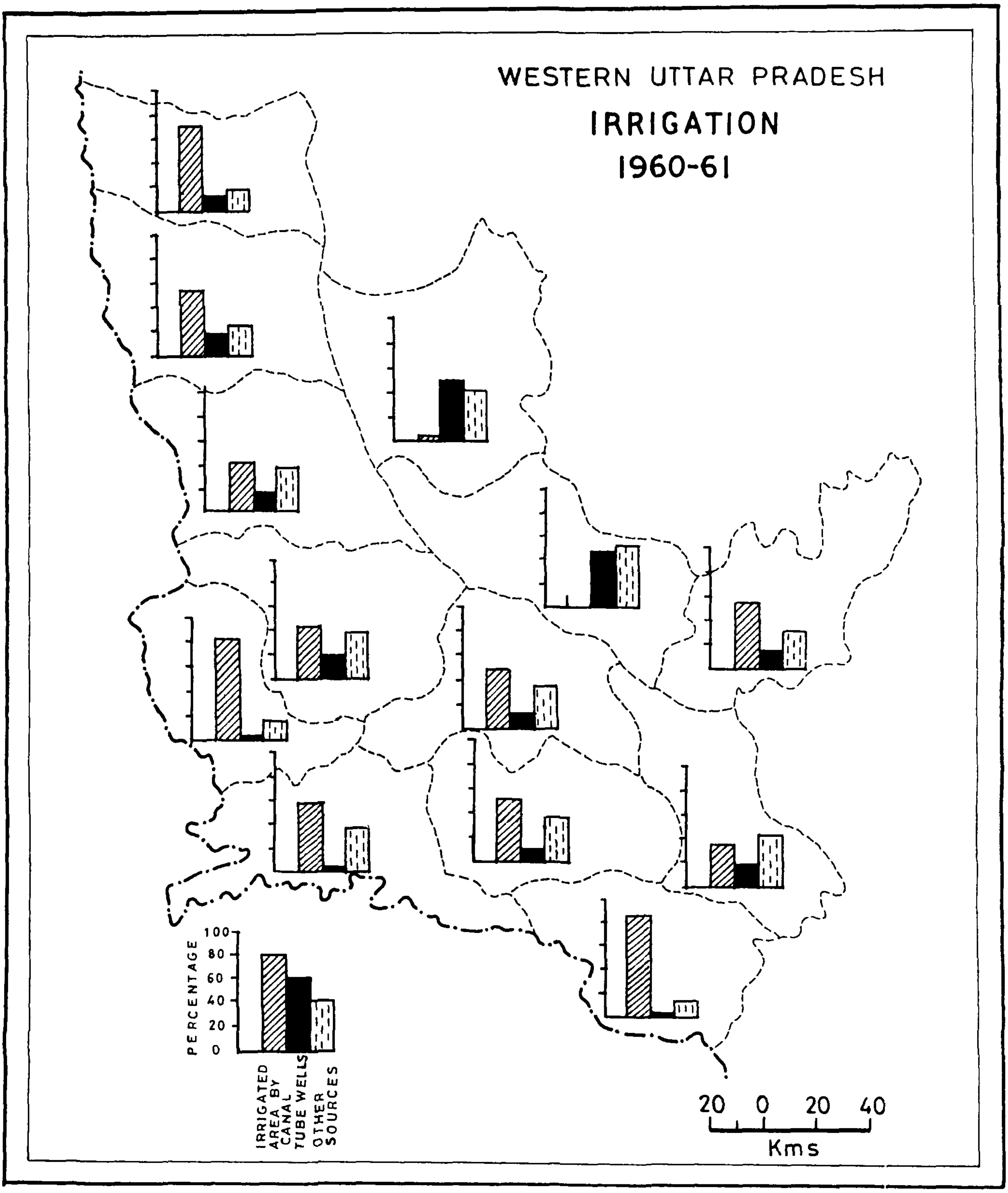

WESTERN UTTAR PRADESH
IRRIGATION
1960-61
PERCENTAGE
100
80
60
40
20
0
IRRIGATED AREA BY CANAL
TUBE WELLS
OTHER SOURCES
20 0 20 40
Kms

FIG. 10

tube-wells. Irrigation from tube-wells is extensive in the remaining districts where they provide irrigation to less than 20 per cent of the net irrigated area. This is perhaps more because of easy availability of canal water.

Other Sources

The districts which were having more than 80 per cent of the area irrigated by other sources are Budaun, Moradabad and Farrukhabad. There were seven districts namely, Merrut, Bulandshahr, Aligarh, Agra, Mainpuri, Etah and Shahjahanpur which receive irrigation between 20 to 80 per cent through this source. The remaining districts of Muzaffarnagar, Mathura and Etawah have less than 20 per cent of the net irrigated area irrigated by other sources.

5.0.3 Position of irrigation in 1970-71

Table-III shows that in the year 1970-71 more area has been brought under irrigation. The four districts of Ganga-Yamuna doub, i.e. Muzaffarnagar, Merrut, Bulandshahr and Aligarh have more than 60 per cent of the total area under irrigation and thus fall under high grade of irrigation availability. The districts having an irrigated area between 30 to 60 per cent of the total cropped area are Mathura, Agra, Mainpuri, Etah, Moradabad, Farrukhabad and Etawah. The remaining districts of Shahjahanpur and Budaun with less than 30 per cent of the total

TABLE III

Percent of irrigated area by different sources of Western Uttar Pradesh: 1970-71

Districts	Net Irrigated Area *	Total Irrigated Area **	Irrigated Area by Canals ***	Irrigated Area by Tube-wells ***	Irrigated Area by other sources ***
Muzaffarnagar	74.32	67.72	55.41	33.68	10.89
Meerut	80.76	75.86	45.48	36.24	18.27
Ghaziabad	-	-	-	-	-
Bulandshahr	75.02	63.32	32.30	40.26	27.43
Aligarh	78.50	63.56	33.42	40.37	26.20
Mathura	56.02	46.69	61.85	20.05	18.08
Agra	41.09	35.43	38.43	33.87	27.69
Mainpuri	63.91	52.34	37.87	23.66	38.45
Etah	57.36	48.02	38.51	22.02	39.46
Badaun	34.20	29.73	-	49.90	50.09
Shahjahanpur	30.48	25.75	45.39	25.81	28.78
Moradabad	43.09	37.97	2.60	39.96	57.42
Farrukhabad	42.62	36.80	24.15	43.47	32.36
Etawah	49.60	43.92	61.25	11.87	26.86

Source : <u>Statistical Bulletin of Uttar Pradesh</u> (1970-71), Dircecorate of Agriculture, Lucknow, U.P.

Note:

* - Percentage of net irrigated area from net cropped area.

** - Percentage of total irrigated area from total cropped area.

*** - Percentage of irrigated area by canals/tube-wells/other sources from net irrigated area.

cropped area under irrigation fall under low grade in terms of irrigation.

Canals

Fig.11 shows that the districts which have more than 50 per cent irrigated area to the net irriagted area through this source are Muzaffarnagar, Mathura and Etawah. The districts which have between 25 to 50 per cent canal irrigated area to the net irrigated area are Merrut, Bulandshahr, Aligarh, Agra, Mainpuri, Etah and Shahjahanpur. The remaining districts of Moradabad and Farrukhabad receive canal irrigation in less than 25 per cent of the net irrigated area.

Tube-Wells

Four districts of the region namely, Bulandshahr, Aligarh, Budaun and Farrukhabad depend heavily on tube-wells which irrigate more than 40 per cent of the net irrigated area. The remaining districts except Etawah receive between 20 to 40 per cent of irrigation water through this source.

Other Sources

There are only two districts namely Budaun and Moradabad which depend heavily on irrigation from other sources which command more than 50 per cent of its net irrigated area. Next in importance are the districts of Bulandshahr, Aligarh, Agra, Mainpuri, Etah, Shahjahanpur, Farrukhabad and Etawah where irrigation from other sources ranges from 25 to 50 per cent of

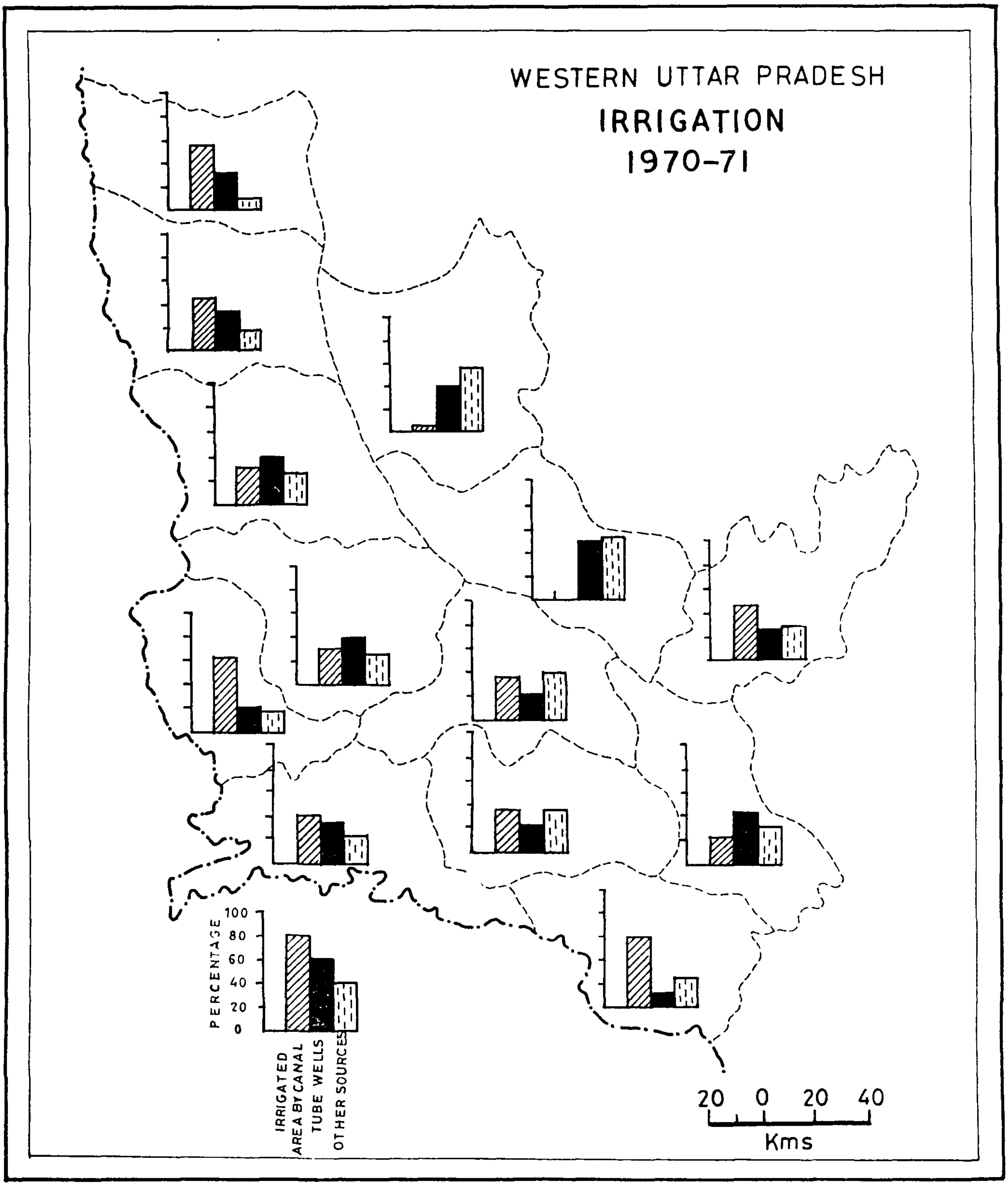

WESTERN UTTAR PRADESH
IRRIGATION
1970-71
PERCENTAGE
100
80
60
40
20
0
IRRIGATED AREA BY CANAL
TUBE WELLS
OTHER SOURCES
20 0 20 40
Kms

FIG.11

the net irrigated area. The other two districts namely Muzaffarnagar and Merrut have less than 25 per cent of the net irrigated area irrigated by other sources.

5.0.4 Position of irrigation in 1980-81

Table-IV reveals that Meerut, Ghaziabad and Bulandshahr districts had high extent of irrigated area in 1980-81 more than 80 per cent of cropped area in these districts was irrigated. The medium extent of irrigation commanding 40 to 80 per cent of the cropped area covers extensive area in the districts of Muzaffarnagar, Aligarh, Mathura, Agra, Mainpuri, Etah, Shahjahanpur, Moradabad, Farrukhabad and Etawah. Budaun is the only districts where irrigation is not common and where less than 40 per cent cropped area is irrigated.

Canals

Fig.12 shows that Mathura and Etawah have more than 50 per cent of the total cultivated area irrigated by canals while the districts of Muzaffarnagar, Merrut, Ghaziabad, Mainpuri, Etah and Shahjahanpur have 25 to 50 per cent area irrigated by this source. The remaining districts had less than 25 per cent of the area under canal irrigation.

Tube-Wells

Tube-well irrigation has increased its intensity in 1980-81 as is evident from an extensive area in Merrut,

TABLE IV

Percent of irrigated area by different sources of Western Uttar Pradesh: 1980-81

Districts	Net Irrigated Area *	Total Irrigated Area **	Irrigated Area by Canals ***	Irrigated Area by Tube-wells ***	Irrigated Area by other sources ***
Muzaffarnagar	85.44	78.97	43.25	55.27	1.46
Meerut	92.80	87.56	32.95	65.71	1.32
Ghaziabad	89.65	83.72	33.82	62.07	4.09
Bulandshahr	98.44	82.29	23.18	70.87	5.94
Aligarh	91.35	70.54	26.54	69.35	4.10
Mathura	82.65	65.17	51.06	47.72	1.20
Agra	65.25	49.76	24.28	70.88	4.83
Mainpuri	81.52	63.41	31.18	59.36	6.45
Etah	74.80	57.50	30.01	50.13	19.85
Badaun	51.63	39.50	0.20	53.85	43.76
Shahjahanpur	57.61	50.99	25.93	60.61	13.44
Moradabad	71.12	59.04	5.07	58.69	36.23
Farrukhabad	64.32	49.62	15.78	73.09	11.12
Etawah	69.07	61.53	64.68	26.41	9.40

Source : Statistical Bulletin of Uttar Pradesh (1980-81), Directorate of Agriculture, Lucknow, U.P.

Note:

* - Percentage of net irrigated area from net cropped area.

** - Percentage of total irrigated area from total cropped area.

*** - Percentage of irrigated area by canals/tube-wells/other sources from net irrigated area.

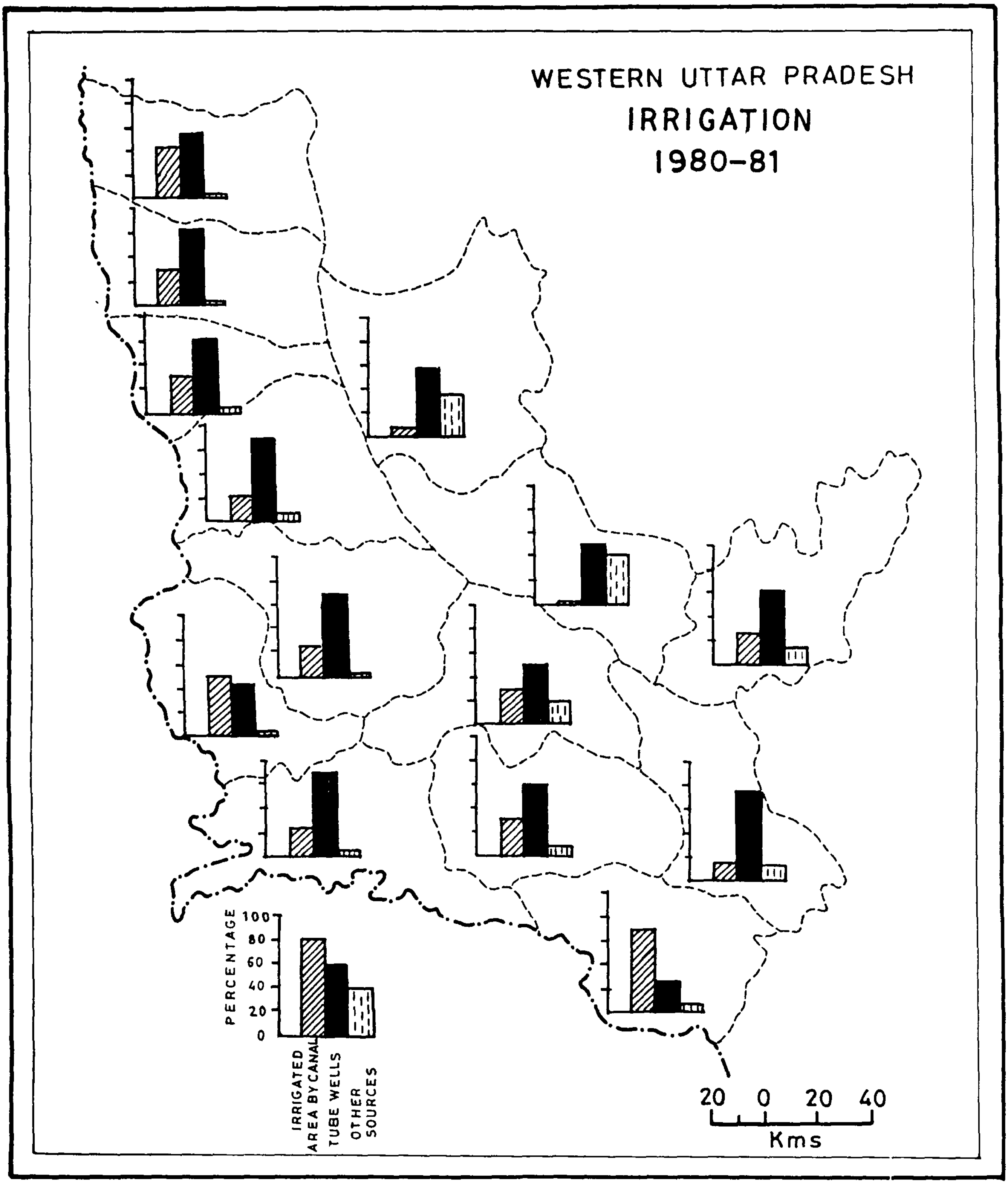

WESTERN UTTAR PRADESH
IRRIGATION
1980-81
PERCENTAGE
100
80
60
40
20
0
IRRIGATED AREA BY CANAL
TUBE WELLS
OTHER SOURCES
20 0 20 40
Kms

FIG.12

Ghaziabad, Bulandshahr, Aligarh, Agra, Shahjahanpur and Farrukhabad districts which receive tube-well irrigation in more than 60 per cent of the cultivated area. In the other six districts namely, Muzaffarnagar, Mathura, Mainpuri, Etah, Budaun and Moradabad 30 to 60 per cent area is irrigated by tube-wells while Etah district has the least area under tube-well irrigation being less than 30 per cent.

Other sources

Other sources have lost their inportance only in Moradabad and Budaun districts where more than 20 per cent of total cropped area is irrigated by other sources while in the remaining districts, it is less than 20 per cent.

5.0.5 Position of irrigation in 1990-91

It is clear from the Table-V that in 1990-91, seven districts namely, Muzaffarnagar, Merrut, Ghaziabad, Bulandshahr, Aligarh, Mathura and Mainpuri had also 80 per cent of the total cropped area under irrigation. This high irrigated area lies over the northern part of the region and in the Ganga-Yamuna doab. The area with medium extent of irrigation is also extensive and lies in two different region in the eastern, northeastern and central part and in the southwestern part of the study region. These medium irrigation spread regions cover seven districts, nemely Agra, Etah, Budaun, Shahjahanpur, Moradabad, Farrukhabad and Etawah.

TABLE V

Percent of irrigated area by different sources of Western Uttar Pardesh: 1990-91

Districts	Net Irrigated Area *	Total Irrigated Area **	Irrigated Area by Canals ***	Irrigated Area by Tube-wells ***	Irrigated Area by other sources ***
Muzaffarnagar	91.08	87.65	38.55	60.46	1.32
Meerut	97.92	96.73	26.42	72.66	0.90
Ghaziabad	88.33	93.87	31.67	59.17	9.15
Bulandshahr	99.84	92.99	19.35	74.61	6.02
Aligarh	91.23	88.95	20.47	78.55	0.97
Mathura	89.18	83.26	39.24	59.86	0.88
Agra	72.66	66.01	16.40	80.96	2.65
Mainpuri	87.31	85.05	27.90	70.30	1.79
Etah	83.78	77.00	22.40	66.50	11.08
Badaun	68.58	60.03	0.10	61.65	38.23
Shahjahanpur	64.35	75.79	12.90	80.91	6.18
Moradabad	63.31	77.11	3.19	73.20	23.59
Farrukhabad	68.70	66.07	11.45	83.61	4.93
Etawah	66.42	68.85	58.33	37.45	4.02

Source : Statistical Bulletin of Uttar Pradesh (1990-91), Directorate of Agriculture, Lucknow, U.P.

Note:

* - Percentage of net irrigated area from net cropped area.

** - Percentage of total irrigated area from total cropped area.

*** - Percentage of irrigated area by canals/tube-wells/other sources from net irrigated area.

Canals

Fig.13 shows that irrigation by canal is important only in Etawah district where it command more than 40 per cent of the cultivated area. Beside it, there are seven districts namely, Muzaffarnagar, Merrut, Ghaziabad, Aligarh, Mathura, Mainpuri and Etah where canal irrigates between 20 to 40 per cent of the cropped area. The districts of Agra, Budaun, Shahjahanpur, Moradabad and Farrukhabad have less than 20 per cent of the cropped area irrigated by canals.

Tube-wells

Tube-wells hold important position as a leading source of irrigation in Agra, Shahjahanpur and Farrukhabad districts and irrigate more than 80 per cent of the cropped area. They are again important source of irrigation in around three fourth area of the region where they provide water to 40 to 80 per cent of the total cropped area especially in the districts of Muzaffarnagar, Merrut, Ghaziabad, Bulandshahr, Aligarh, Mathura, Mainpuri, Etah, Budaun and Moradabad. The only one district, namely Etawah receives tube-well water for its less than 40 per cent of the total cropped area.

Other sources

Only one district, namely Budaun receives more than 30 per cent water of the total irrigated area from other

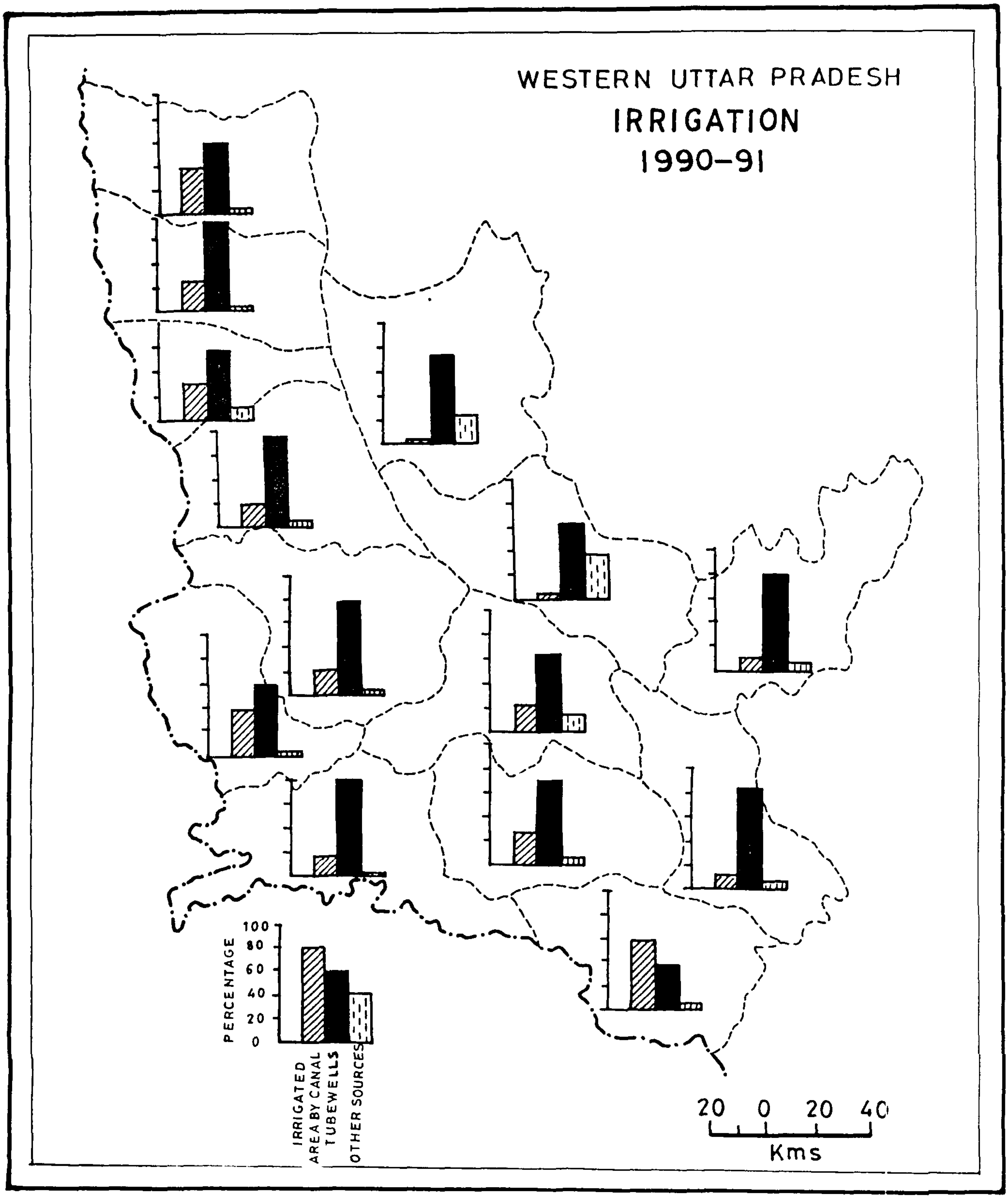

WESTERN UTTAR PRADESH
IRRIGATION
1990-91
100
80
60
40
20
0
PERCENTAGE
IRRIGATED AREA BY CANAL
TUBEWELLS
OTHER SOURCES
20 0 20 40
Kms

FIG.13

sources. In the remaining districts irrigation from other sources is not significant.

From the above analysis it is clear that the area which previously was irrigated by canals and other sources have been overtaken by tube-well irrigation mainly due to spread and diffusion of modern technology and mechanized agriculture. Due to this reason the farmer is able to provide timely water to his operational fields and practice multiple cropping. Because of tube-wells more area have been brought under irrigation which earlier was beyond the reach of irrigation facilities.

5.1 High Yielding Varieties of Seeds

The development of high yielding variety seeds in mid-sixties shed new rays of hope and confidence towards increasing the agricultural productivity in India as well as in the study region in order to meet the challenges of growing population. The high yielding variety seeds are a major inputs of agricultural production under the green revolution technology.They help in double cropping, their short stem can easily carry a heavy fertilizer load and resists wind damage and their larger leaf surface helps in the process of photosynthesis.

Fig.14 & Table-VI shows that in 1970-71, only one district, namely Muzaffarnagar was under high category with around 50 per cent of the total cropped are using HYV seeds. The medium range of utilization was seen in five districts, namely

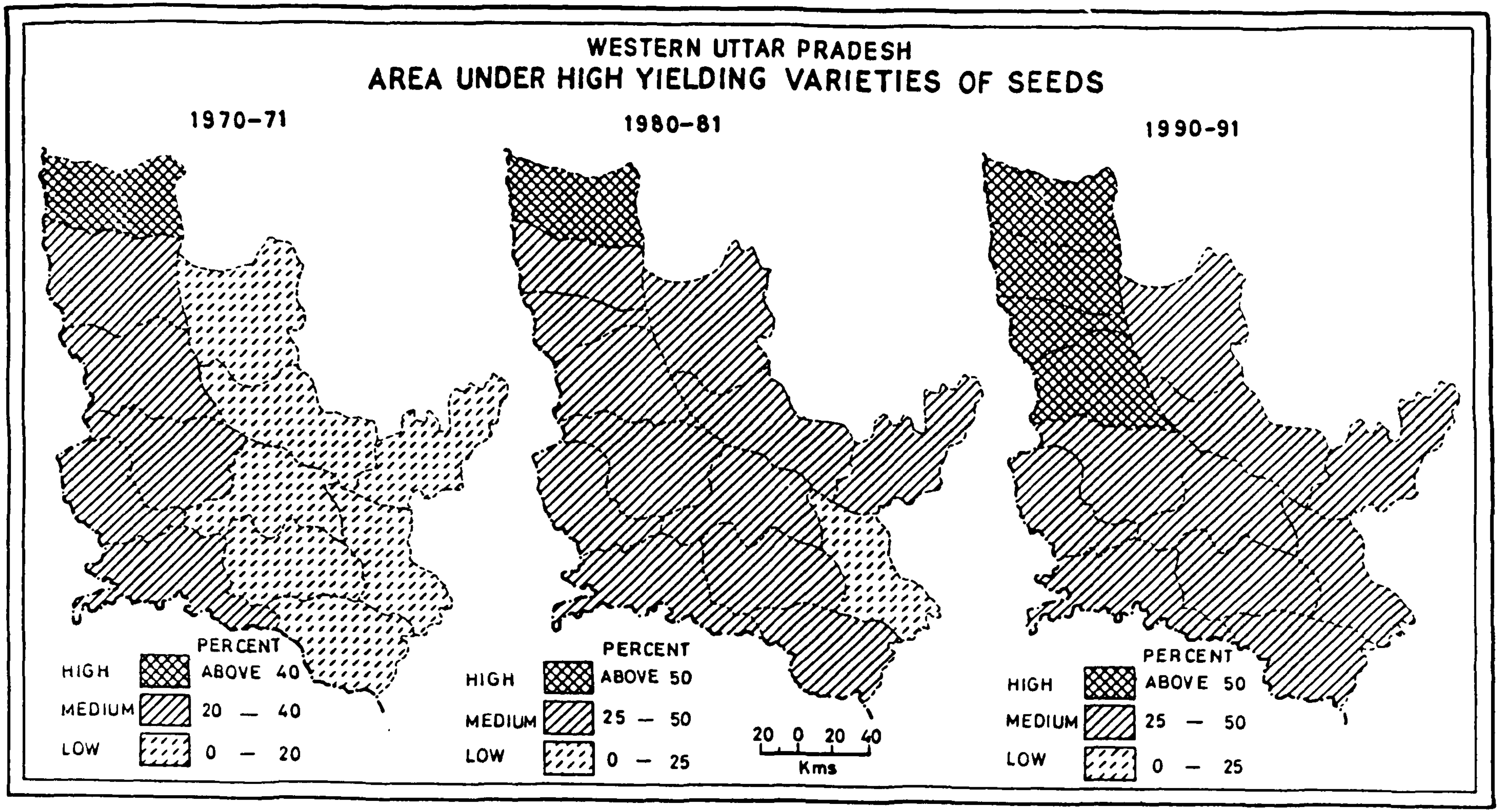

WESTERN UTTAR PRADESH
AREA UNDER HIGH YIELDING VARIETIES OF SEEDS
1970-71
1980-81
1990-91
PERCENT
HIGH ABOVE 40
MEDIUM 20 — 40
LOW 0 — 20
PERCENT
HIGH ABOVE 50
MEDIUM 25 — 50
LOW 0 — 25
20 0 20 40
Kms
PERCENT
HIGH ABOVE 50
MEDIUM 25 — 50
LOW 0 — 25

FIG.14

Merrut, Bulandshahr, Aligarh, Mathura and Agra where the total area under high yielding variety of seeds ranged between 20 to 40 per cent of the total cultivated area. The remaining districts were placed under low category where the area under HYV seeds lying below 20 per cent of the total cultivated area. In 1980-81, there was substantial change and more area was brought under high yielding variety of seeds. The district of Muzaffarnagar still was placed under high category with more than 50 per cent of the total cultivated area under high yielding variety of seeds. The remaining districts except Farrukhabad recorded medium category with a percentage share of the total cultivated area ranging between 25 to 50 per cent.

TABLE VI
Percentage of area under high yielding varieties of seeds from total cropped area in Western Uttar Pradesh

Districts	1970-71	1980-81	1990-91
Muzaffarnagar	50.29	58.45	65.45
Meerut	35.62	40.62	57.58
Ghaziabad	-	37.74	70.30
Bulandshahr	32.08	36.94	57.36
Aligarh	30.64	40.22	30.47
Mathura	20.13	36.99	40.35
Agra	20.19	30.39	35.25
Mainpuri	18.69	27.63	35.72
Etah	19.32	32.16	40.37
Badaun	15.57	33.20	40.33
Shahjahanpur	18.94	32.11	42.09
Moradabad	15.36	26.25	30.93
Farrukhabad	17.12	24.11	32.48
Etawah	12.76	27.21	31.24

Source : Based on the data obtaining from Agricultural Bulletin of Uttar Pradesh, Directorate of Agriculture, Lucknow, U.P.

In 1990-91, the area under high category increase greatly and spread over four districts of Ganga-Yamuna daoab, namely Muzaffarnagar, Merrut, Ghaziabad and Bulandshahr. In these districts more than half of the total cropped area was devoted to high yielding varieties of seeds. All the remaining districts lying in the eastern, western and central parts of the region also improvea their positions and were placed in medium category with 25 to 50 per cent of their cropped area under these varieties of seeds.

5.2. Fertilizers

The findings of first and second five year plans point out that under conditions prevalent in India, fertilizers are responsible for an increase of about 45 per cent in the agricultural production. In view of its overwhelming impact on agricultural production, it was thought worthwhile to know the consumption level of fertilizers in western Uttar Pradesh.

Fig.15 and Table-VII reveals that the district-wise consumption of fertilizers has substantially increased in the region since 1970-71 to 1990-91.

In 1970-71, there were three districts, namely Muzaffarnagar, Merrut and Bulandshahr recorded a high grade of fertilizer consumption of above 30 kg per hectare. The districts which fall under medium grade fertilizer consumption are Moradabad, Shahjahanpur and Aligarh where the rate of consumption varies from 15 to 30 kg per hectare. The other seven

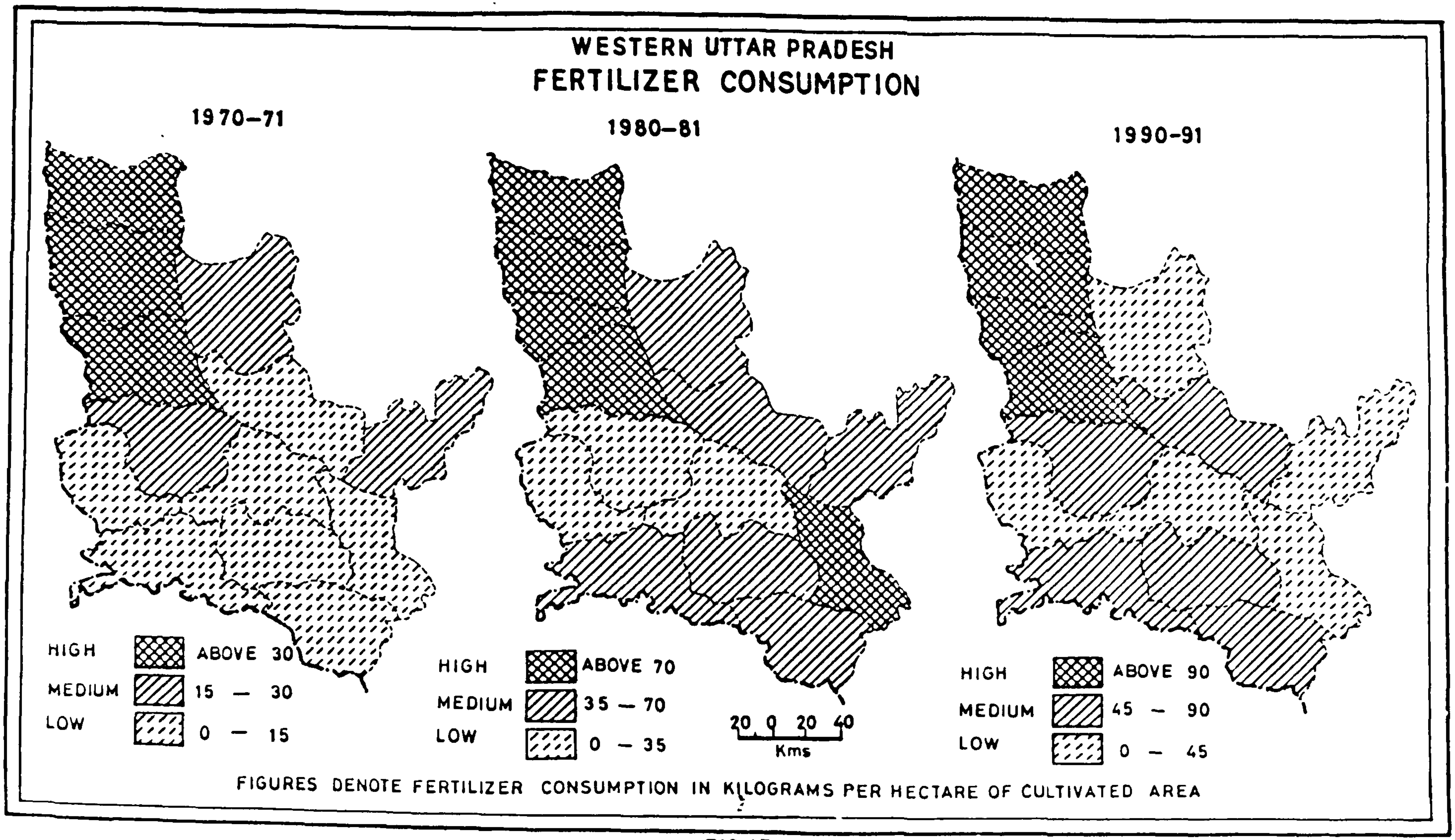

WESTERN UTTAR PRADESH
FERTILIZER CONSUMPTION
1970–71
1980–81
1990-91
HIGH
MEDIUM
LOW
ABOVE 30
15 — 30
0 — 15
ABOVE 70
35 — 70
0 — 35
20 0 20 40
Kms
ABOVE 90
45 — 90
0 — 45
FIGURES DENOTE FERTILIZER CONSUMPTION IN KILOGRAMS PER HECTARE OF CULTIVATED AREA

FIG.15

districts, namely Mathura, Agra, Etah, Budaun, Mainpuri, Farrukhabad and Etawah fall under low grade of fertilzer consumption where the consumption was less than 15 kg per hectare.

TABLE VII
Distribution of chemical fertilizers in Kilogram per hectare in Western Uttar Pradesh

Districts	1970-71	1980-81	1990-91
Muzaffarnagar	62.99	78.44	160.01
Meerut	55.03	100.57	105.74
Ghaziabad	-	71.36	102.40
Bulandshahr	40.44	80.03	94.95
Aligarh	17.71	34.80	45.08
Mathura	11.82	32.68	41.08
Agra	13.88	41.62	49.41
Mainpuri	9.07	37.77	45.98
Etah	10.03	34.92	36.44
Badaun	14.38	43.30	52.18
Shahjahanpur	15.05	35.33	40.60
Moradabad	15.72	37.64	42.04
Farrukhabad	12.20	73.40	42.81
Etawah	12.52	42.47	48.04

Source : Based on the data obtaining from Agricultural Bulletin of Uttar Pradesh, Directorate of Agriculture, Lucknow, U.P.

The fertilizer diffusion was taking place in 1980-81 when its high consumption spread to five districts, namely Muzaffarnagar, Merrut, Ghaziabad, Bulandshahr and Farrukhabad with a consumption rate of over 70 kg per hectare. There were two patches of medium grade consumption. The first patch in north-eastern part comprises of the districts of Moradabad, Budaun and Shahjahanpur and the other lies in southern part of the region comprising the districts of Agra, Mainpuri and Etawah. In this category the fertilizer consumption varies between 35 to 70 kg. per hectare. The remaining three districts namely, Aligarh, Mathura and Etah recorded low grade of fertilizer consumption being less than 35 kg per hacatare.

In 1990-91, there was substantial increase in the consumption of fertilizers in the region. Four districts, namely Muzaffarnagar, Merrut, Ghaziabad and Bulandshahr which lie in Ganga-Yamuna doab fall under high grade of fertilizer consumption category where its consumption is above 90 kg per hectare. There were five districts, namely Aligarh, Budaun, Agra, Mainpuri and Etawah where the consumption was of medium level ranging from 45 to 90 kg per hectare. The remaining five districts of Moradabad, Shahjahanpur, Mathura, Etah and Farrukhabad recorded low fertilizer consumption or less than 45 kg per hectare.

5.3 Agricultural Implements and Machinery

Agricultural implements and machinery are strong inputs for better productivity of land because their use increases farm efficiency, saves time and minimizes production cost. The type of machinery is changing fast, the older ones are replaced by better performing new ones leading to further increase in farm efficiency and farm output. It is therefore, better to know the position of farm machinery in different periods of time for assessing the nature of agricultural development of those periods.

5.3.1 Tractors

From Table-VIII & Fig. 16 it is possible to recognise three regions of high, medium and low tractor density in the area in 1970-71. High concentration of more than 40 tractors per ten thousand hectares of cropped land is obtained in two districts of Muzaffarnagar and Merrut, 20 to 40 tractors with medium concentration are seen in Bulandshahr, Aligarh, Mathura, Agra, Mainpuri and Moradabad and low concentration of tractors with a density of less than 20 tractors per ten thousand hectares of cultivated area is found in Budaun, Etah, Shahjahanpur, Farrukhabad and Etawah.

The number of tractors increased in 1980-81, when seven districts, namely Muzaffarnagar, Merrut, Ghaziabad, Bulandshahr, Mathura, Agra and Budaun had above 60 tractors per ten thousand hectares of cultivated area. Medium category districts, viz. Aligarh, Moradabad, Shahjahanpur and Etawah had 30 to 60 tractors per ten thousand hectares of cropped area. The low density of less than 30 tractors per ten thousand hectares of cropped area is found in Etah, Mainpuri and Etawah districts.

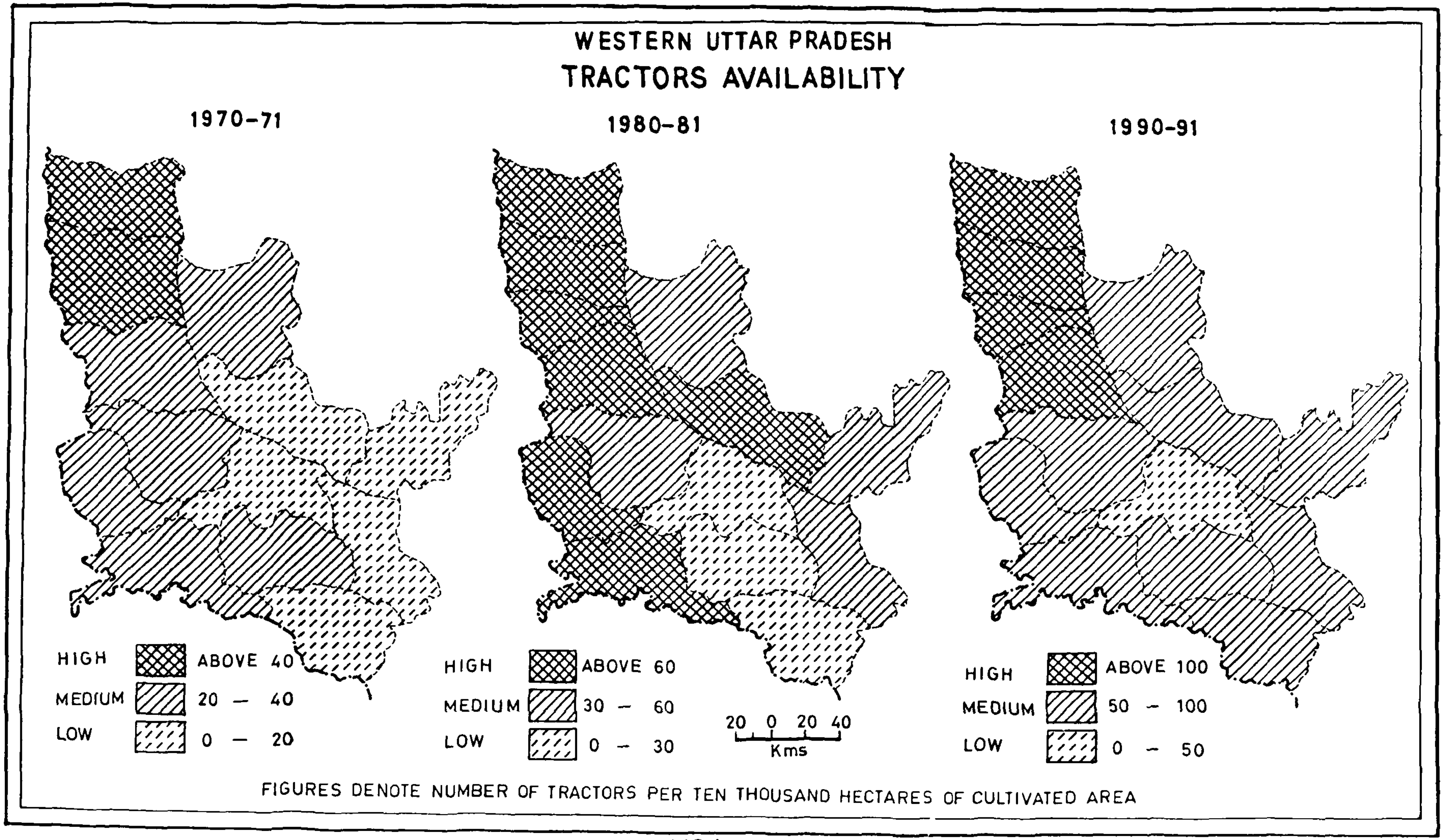

WESTERN UTTAR PRADESH
TRACTORS AVAILABILITY
1970-71
1980-81
1990-91
HIGH ABOVE 40
MEDIUM 20 — 40
LOW 0 — 20
HIGH ABOVE 60
MEDIUM 30 — 60
LOW 0 — 30
20 0 20 40
Kms
HIGH ABOVE 100
MEDIUM 50 — 100
LOW 0 — 50
FIGURES DENOTE NUMBER OF TRACTORS PER TEN THOUSAND HECTARES OF CULTIVATED AREA

FIG.16

TABLE VIII
Districtwise number of tractors per ten thousand hectares of cropped area in Western Uttar Pradesh

Districts	1970-71	1980-81	1990-91
Muzaffarnagar	89.94	220.81	292.84
Meerut	67.91	167.91	240.31
Ghaziabad	-	116.69	259.23
Bulandshahr	29.02	74.98	138.82
Aligarh	20.67	39.63	66.75
Mathura	37.86	88.55	80.79
Agra	25.09	61.28	84.39
Mainpuri	24.78	28.70	60.80
Etah	19.26	23.03	48.26
Badaun	18.49	108.89	61.02
Shahjahanpur	15.06	30.16	58.70
Moradabad	20.46	42.64	72.93
Farrukhabad	15.65	39.45	72.58
Etawah	17.11	28.24	60.01

Source : Based on the data obtained from Agricultural Bulletin of Uttar Pradesh, Directorate of Agriculture, Lucknow, U.P.

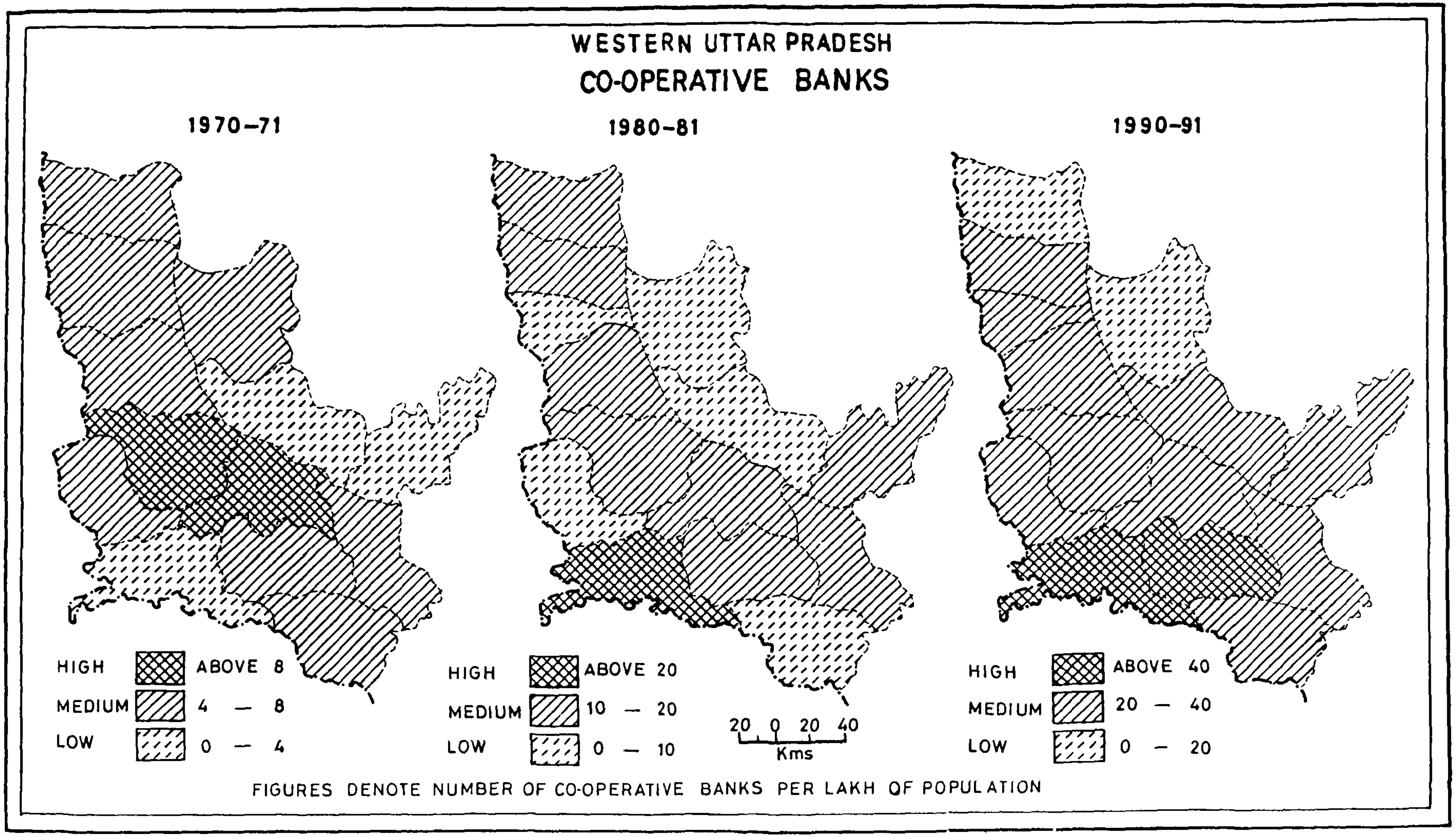
Tractorization further increased in 1990-91. During this period, there were four districts, viz., Muzaffarnagar, Merrut, Ghaziabad and Bulandshahr which were using more than 100 tractors per ten thousand hectares of cultivated area. Medium density districts were Aligarh, Mathura, Agra, Moradabad, Budaun, Shahjahanpur, Mainpuri, Farrukhabad and Etawah where the density ranged between 50 to 100 tractors per ten thousand hectares of cropped land. Only one district, namely Etah lagged behind with only below 50 tractors per ten thousand hectares of cropped land.

5.4 Cooperative Banks

Cooperative banks are regarded as the best agency to provide productive loans to the farmers for purchasing different agricultural inputs. These banks are the basis of whole credit structure and finance the primary agricultural credit societies of the districts level with respect to their short and medium term loan requirements. These banks also finance the village cooperative society.

Table-IX and Fig.17 shows distrrictwise number of cooperative banks per lakh of population from 1970-71 to 1990-91. In 1970-71, two districts, namely Aligarh and Etah were placed under high category with more than 8 cooperataive banks per lakh of population. The districts which fall under medium category with 4 to 8 cooperative banks per lakh of population are Muzaffarnagar, Merrut, Bulandshahr, Mathura, Moradabad, Mainpuri, Farrukhabad and Etawah. The remaining three districts, namely Agra, Shahjahanpur and Budaun with less than 4 cooperative banks per lakh of population were recognised as of low level in terms of banking facilities.

In 1980-81, there was substantial increase in the number of cooperative banks per lakh of population. The district of Agra had the highest number or more than 20 cooperative banks per lakh of population. The medium category districts were Muzaffarnagar, Merrut, Bulandshahr, Aligarh, Etah, Mainpuri, Shahjahanpur and Farrukhabad with 10 to 20 cooperative banks per lakh of population. The districts which have low number of


WESTERN UTTAR PRADESH
CO-OPERATIVE BANKS
1970–71
1980–81
1990–91
HIGH
ABOVE 8
MEDIUM
4 — 8
LOW
0 — 4
HIGH
ABOVE 20
MEDIUM
10 — 20
LOW
0 — 10
20 0 20 40
Kms
HIGH
ABOVE 40
MEDIUM
20 — 40
LOW
0 — 20
FIGURES DENOTE NUMBER OF CO-OPERATIVE BANKS PER LAKH OF POPULATION

FIG·17

cooperative banks or less than 10 per lakh of population are Ghaziabad, Mathura, Budaun, Moradabad and Etawah.

TABLE IX

Districtwise number of Co-operative banks per lakh of population in Western Uttar Pradesh

Districts	1970-71	1980-81	1990-91
Muzaffarnagar	6.06	10.29	19.96
Meerut	7.67	12.76	23.80
Ghaziabad	-	8.13	30.63
Bulandshahr	5.04	15.14	30.32
Aligarh	9.84	17.79	30.57
Mathura	6.77	9.71	30.34
Agra	2.12	30.14	80.41
Mainpuri	6.97	17.18	82.61
Etah	9.95	11.17	22.50
Badaun	3.73	6.06	24.64
Shahjahanpur	3.95	10.12	35.15
Moradabad	4.97	8.97	15.54
Farrukhabad	6.24	10.19	24.88
Etawah	4.98	9.18	33.88

Source : Based on the data obtained from Agricultural Bulletin of Uttar Pradesh, Directorate of Agriculture, Lucknow, U.P.

While in 1990-91, Mainpuri and Agra districts were placed under high category with above 40 cooperative banks per lakh of population, the medium category districts are Merrut, Ghaziabad, Bulandshahr, Aligarh, Mathura, Etah, Budaun, Shahjahanpur, Farrukhabad and Etawah with 20 to 40 cooperative banks per lakh of population. The districts of Muzaffarnagar and Merrut had less than 20 cooperative banks per lakh of population.

5.5 Land Holdings

The efficiency of agricultural production, the margin of profit and the scope of its development are strongly influenced by the size of individual holdings. The optimum size of a holding is decided by factors like fertility of soil, prevailing climate and economic condition of the farmer. The Agricultural Statistical Department has recognised five main classes of holdings as given in Table-X.

In 1985-86, there were 40.03 lakh operational holdings in the region of which 63.20 per cent were marginal or less than one hectare in size. The number of small holdings of the size of 1 to 2 hectares were 7.64 lakh or nearly 19.08 per cent of the total holdings of Western Uttar Pradesh. Semi-medium holdings with a size of 2 to 4 hectares accounted for about 12.18 per cent of the total holdings of the region. The total number of holdings under this category were 4.87 lakh. The medium size holdings 4 to 10 hectares were in all 2.07 lakh which accounted for only 5.17 per cent of the total holdings of the region. However, the large holdings are small in number being 0.15 lakh in all or 0.37 per cent of the total holdings of the region.

It is clear from the above description that two categories of holdings, viz. those below one hectare and those with 1 to 2 hectares in size constitute about more than 82 per

TABLE X

Area and Number of Holdings of various categories in Western Uttar Pradesh : 1985-86

DISTRICTS CATEGORY	MARGINAL (< 1 Hectare) Number of Holdings	Total Area	Average area per Holding	SMALL (1 to 2 Hectare) 1	2	3	SEMI-MEDIUM (2 to 4 Hectare) 1	2	3	MEDIUM (4 to 10 Hectare) 1	2	3	LARGE (> 10 Hectare) 1	2	3	TOTAL FOR DISTRICT 1	2	3
MUZAFFARNAGAR	147137	51516	0.35	45431	63276	1.39	34895	100321	2.87	19516	112092	6.37	1766	26142	14.80	248745	353347	1.42
	(59.15)	(14.57)		(18.26)	(17.90)		(14.02)	(28.39)		(7.84)	(31.72)		(0.70)	(7.39)				
MEERUT	137804	52557	0.38	46018	64128	1.39	33441	95561	2.77	15610	86504	5.54	944	13697	14.50	233817	312447	1.33
	(58.95)	(16.82)		(19.68)	(20.52)		(14.30)	(30.58)		(6.67)	(27.68)		(0.40)	(4.38)				
BULANDSHAHR	136884	58155	0.42	52280	69039	1.32	37273	102749	2.75	16278	91337	5.61	1257	17677	14.06	243972	338957	1.38
	(56.10)	(17.15)		(21.42)	(20.36)		(15.27)	(30.31)		(6.67)	(26.94)		(0.51)	(5.21)				
GHAZIABAD	102509	40448	0.39	30874	43188	1.39	19172	53327	2.78	7785	43052	5.53	661	9985	15.10	161001	190000	1.18
	(63.66)	(21.28)		(19.17)	(22.73)		(11.90)	(28.06)		(4.83)	(22.65)		(0.41)	(5.25)				
ALIGARH	131589	52927	0.40	54844	75990	1.38	41901	113954	2.70	22237	124420	5.59	1646	21849	13.27	252217	389140	1.54
	(52.17)	(13.60)		(21.74)	(19.52)		(16.61)	(29.28)		(8.81)	(31.97)		(0.65)	(5.61)				
MATHURA	69501	30263	0.43	37494	53828	1.43	33073	92331	2.79	20058	114585	5.11	1639	22395	13.66	161765	313402	1.93
	(42.96)	(9.65)		(23.17)	(17.17)		(20.44)	(29.46)		(12.39)	(36.56)		(1.01)	(7.14)				
AGRA	124645	52836	0.42	52068	73309	1.40	38912	108517	2.78	18363	103350	5.62	1334	19098	14.31	235322	357110	1.51
	(52.96)	(14.79)		(22.12)	(20.52)		(16.53)	(30.38)		(7.80)	(28.94)		(0.56)	(5.34)				
MAINPURI	247957	102101	0.41	60595	85424	1.40	28437	77306	2.71	9286	51262	5.52	605	8093	13.37	346880	324186	0.93
	(72.00)	(31.49)		(17.46)	(26.35)		(8.19)	(23.84)		(2.67)	(15.81)		(0.17)	(2.49)				
ETAH	213053	85460	0.41	59832	84982	1.42	34742	98306	2.82	10747	60202	5.60	612	9192	15.01	318986	338142	1.06
	(66.79)	(25.05)		(18.75)	(25.17)		(10.89)	(29.15)		(3.36)	(17.85)		(0.19)	(2.72)				
BUDAUN	274021	109393	0.39	75255	104686	1.39	42138	115887	2.75	15280	84629	5.53	1021	13885	13.59	407715	428480	1.05
	(67.20)	(25.53)		(18.45)	(24.43)		(10.33)	(27.04)		(3.74)	(19.75)		(0.25)	(3.25)				
SHAHJAHANPUR	241800	94262	0.39	64942	90282	1.39	34393	92869	2.70	11841	64858	5.47	917	13950	15.21	353893	356221	1.00
	(68.32)	(26.46)		(18.35)	(25.34)		(9.71)	(26.07)		(3.34)	(18.20)		(0.25)	(3.91)				
MORADABAD	227006	90632	0.39	77193	108840	1.40	52373	142018	2.71	20468	118403	5.78	1397	20893	14.95	378437	480786	1.27
	(59.93)	(18.85)		(20.39)	(22.63)		(13.85)	(29.53)		(5.40)	(24.64)		(0.36)	(4.34)				
FARRUKHABAD	284090	94540	0.33	52812	71495	1.35	26513	70693	2.66	8888	49092	5.52	608	8376	13.77	372911	294196	0.78
	(76.18)	(32.13)		(14.18)	(24.30)		(7.10)	(24.02)		(2.38)	(16.68)		(0.16)	(2.84)				
ETAWAH	191270	78677	0.41	54532	77022	1.41	30443	82624	2.71	10699	58764	5.49	639	8555	13.38	287583	305642	1.06
	(66.50)	(25.74)		(18.96)	(25.20)		(10.58)	(27.03)		(3.72)	(19.24)		(0.22)	(2.79)				
WESTERN UTTAR PRADESH	2529266	993767	0.39	764170	1065489	1.39	487706	1346463	2.75	207056	1162550	5.63	15046	213787	14.21	4003244	4782056	1.19
	(63.20)	(20.79)		(19.08)	(22.75)		(12.18)	(28.15)		(5.17)	(24.34)		(0.37)	(4.47)				

Source : Based on the data obtained from Agricultural Bulletin of Uttar Pradesh (1985-86), Directorate of Agriculture, Lucknow U P

Note : Figures in brackets are percentages to the total of districts cent of the total holdings in the region. The other three categories constitute only 18 per cent of the total number of holdings. Majority of farmers in the region thus have to depend on marginal and small agricultural holdings for their livelihood.

5.6 Literacy

Literacy has been selected as one of the indicators to measure agricultural development because new ideas and techniques are adopted by educated farmers, which lead towards the progress of agriculture. The rate of adoption of new ideas and practices is higher among the literate farmers than their illiterate counter parts.

For the year 1990-91, the districtwise distribution of literate persons in the study area is given in Table-XI and their high, medium and low concentration is shown in Fig.18. It is clear from the figure that the high concentration with litearcy of above 40 per cent is seen in three districts of Merrut, Ghaziabad and Etawah. Medium concentration of literate persons is found in the central and south western parts of the region including the districts of Muzaffarnagar, Bulandshahr, Aligarh, Mathura, Agra, Etah, Mainpuri and Farrukhabad. The percentage of literate persons to the total population here ranges from 20 to 40 per cent. The

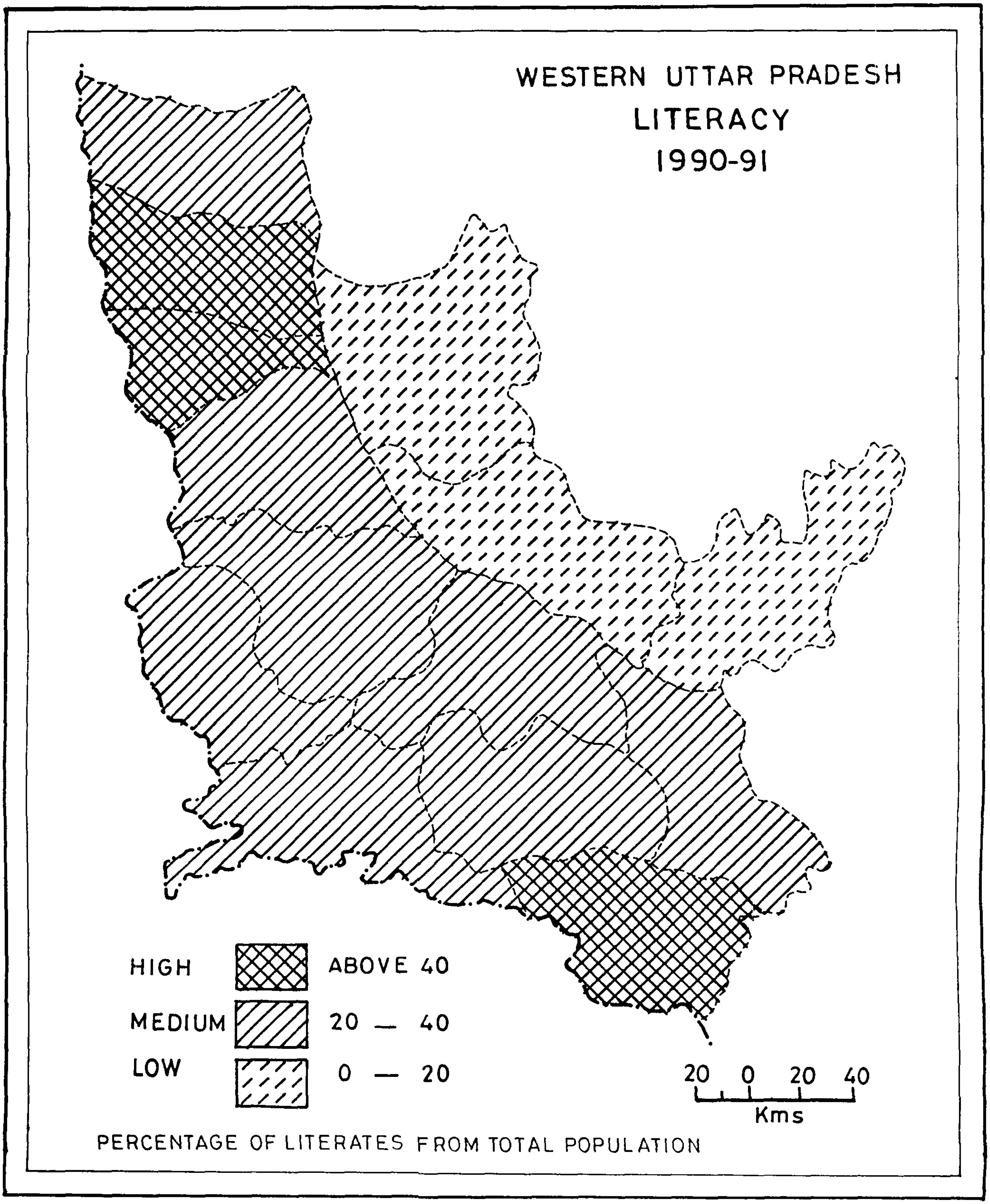

WESTERN UTTAR PRADESH
LITERACY
1990-91
HIGH
ABOVE 40
MEDIUM
20 — 40
LOW
0 — 20
20 0 20 40
Kms
PERCENTAGE OF LITERATES FROM TOTAL POPULATION

FIG.18

remaining three districts, namely Moradabad, Budaun and Shahjahanpur fall under low concentration of literate persons where the number of literate persons lies below 20 per cent.

TABLE XI

Districtwise number of literate persons and their percentage to total population in Western Uttar Pradesh.

Districts	No. of Literate Persons	Percentage to the total population
Muzaffarnagar	1029309	35.14
Meerut	1416627	41.26
Ghaziabad	1226285	44.50
Bulandshahr	1017565	36.00
Aligarh	1187504	36.13
Mathura	687884	35.79
Agra	1074639	39.03
Mainpuri	521620	39.95
Etah	710222	31.70
Badaun	519681	26.22
Shahjahanpur	474865	19.46
Moradabad	1017125	24.78
Farrukhabad	935758	39.99
Etawah	921704	43.61

Source : Census of India, New Delhi, Government of India, 1990-91.

CHAPTER VI

DISTRICT WISE AREA, PRODUCTION AND YIELD OF MAJOR CROPS

6.0 The variations in soil fertility and water supply in Western Uttar Pradesh lead to variations in the farming patterns and productivity level in the area. A review of overall changes in area, production and yield of major crops is therefore essential to come a clear picture of agricultural development. The growth pattern with reference to agriculture assume special importance in a planned economy because it helps in locating the weaknesses in the existing programme of agricultural development. The time period chosen for analysis of these trends in post-independence period from 1950-51 to 1990-91. The study is bound to be highly revealing as it relates to a region which is well advanced in agriculture and the study is based on a forty years data. An analysis of the broad trends of yield per hectare (productivity) on the basis of historical time series is useful in planning of perspective agricultural development in the region. Statistical analysis of the behavioural pattern of area, production and yield of the selected crops give an insight into effectiveness of various economic forces operating in the region. It is not possible to collect reasonably accurate data directly from the farmers for so many years past. Therefore, the researcher has to depend entirely on the secondary data collected from various agencies of government and semi-government organisations mainly the Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, Government of India, New Delhi and the Directorate of Economics and Statistics, Lucknow, U.P.

The study concentrates mainly on the trends in area, production and yield in all the fourteen districts of Uttar Pradesh. Important crops considered for this purpose are cereals (rice, jowar, bajra, maize, wheat, barley), pulses (gram, arhar, masoor), cash crops (sugar cane and potato) and oilseeds (til, mustard and groundnut) for eight quinquennial periods, i.e. 1950-55, 55-60, 60-65, 65-70, 70-75, 75-80, 80-85 and 85-90 and an overall growth from 1950-1990.

6.1 Muzaffarnagar

The variations in area, production and yield of major crops is shown in Table XII and its trend can be seen from Fig. 19. The table reveals that Muzaffarnagar district experience an increasing trend in the area under cereals in four periods, i.e. by 7,924 hectares (4.67 per cent) in 1950-55, by 3,979 hectares (2.24 per cent) in 1955-60, by 5,611 hectares (3.09 per cent) in 1960-65 and the highest by 31,038 hectares (16.59 per cent) in all the eight quinquennial periods in 1965-70. In the next period in 1970-75, however, the area decreased to 1,3649, hectares (6.25 per cent) but it again increased to 22,923 hectares (11.21 per cent) in 1975-80 and by

TABLE XII

Variations in area, production and yield of major crops in Muzaffarnagar District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	7924	3979	5611	31038	-13649	22923	10915	-50929	17812
		(4 97)	(2 24)	(3 09)	(16 59)	(-6 25)	(11 21)	(4 80)	(-21 37)	(10 50)
	P	-32196	45511	27666	129897	-9023	125055	96671	-30240	353341
		(-20 07)	(35 49)	(15 92)	(64 50)	(-2 72)	(38 80)	(21 61)	(-5 55)	(220 28)
	Y	-2 24	2 35	1 19	4 43	0 57	3 91	3 16	4 59	17 96
		(-23 67)	(32 54)	(12 43)	(41 17)	(3 75)	(24 80)	(16 06)	(20 10)	(189 85)
PULSES										
	A	-14153	3107	-7114	-23212	-11010	-2575	-4055	-1108	-60120
		(-21 95)	(6 17)	(-13 31)	(-50 11)	(-47 65)	(-2129)	(-42 60)	(-20 28)	(93 24)
	P	-5156	6504	-11343	-16143	-9841	-3187	1042	-357	-38491
		(-11 91)	(17 06)	(-25 41)	(-48 50)	(-57 41)	(-43 66)	(25 34)	(-6 92)	(-88 92)
	Y	0 86	0 78	-1 17	0 23	-1 38	-1 72	5 12	1 58	4 30
		(12 81)	(10 30)	(-14 01)	(3 20)	(-18 62)	(-28 52)	(118 79)	(16 75)	(64 08)
CASH CROPS										
	A	7379	16053	3828	29436	24407	10808	15602	20299	127812
		(9 69)	(19 22)	(3 84)	(28 47)	(18 37)	(6 87)	(9 28)	(11 05)	(167 88)
	P	248075	1351496	472359	1928418	564202	134861	195374	1000624	8865726
		(9 78)	(48 57)	(11 42)	(41 86)	(8 63)	(18 97)	(23 13)	(9 62)	(349 81)
	Y	0 29	82 03	30 31	46 52	-40 49	51 11	63 69	-7 30	226 09
		(0 08)	(24 62)	(7 29)	(10 44)	(-8 23)	(11 32)	(12 68)	(-1 28)	(68 08)
OILSEEDS										
	A	-315	-508	-122	57	831	523	2043	485	2994
		(-21 98)	(-45 43)	(-20 00)	(-11 68)	(152 47)	(38 00)	(107 58)	(12 30)	(208 93)
	P	-408	-31	17	10	619	264	1499	405	2375
		(-62 67)	(-12 75)	(8 01)	(4 36)	(258 99)	(30 76)	(133 60)	(15 45)	(78 48)
	Y	-2 37	1 30	1 22	-0 31	1 85	-0 33	0 74	0 19	2 29
		(-52 20)	(59 90)	(35 15)	(-6 60)	(42 23)	(-5 29)	(12 54)	(2 86)	(50 44)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

10,915 hectares (4.80 per cent) in 1980-85. The area again decreased by 50,929 hectares (21.37 per cent) in 1985-90. The overall increase between 1950-1990 in the cereal area was of the magnitude of 17,812 hectares or 10.50 per cent.

The area under pulses on the other hand shows a decreasing trend. The area under pulses decreased in all the eight quinquennial periods except in 1955-60 when it increased by 3,107 hectares (6.17 per cent). The highest decrease in area by 23,212 hectares (50.11 per cent) was recorded in 1965-70. The overall decrease in area under pulses from 1950-1990 was about 60,120 hectares (83.24 per cent).

The area under cash crops shows a consistently positive growth. It increased by 7,379 hectares (9.69 per cent) in 1950-55 and in the next quinquennial period it increased by 16,053 hectares (19.22 per cent). The lowest increase in area was recorded in the period 1960-65 when it increase by 3,828 hectares (3.84 per cent). The highest increase in area was recorded in 1965-70 when it increased by 29,436 hectares (28.47 per cent). The remaining four quinquennial periods show a continuous increasing growth rate. The overall increase in area under cash crop from 1950-1990 is about 127,812 hectares (167.88 per cent).

The area under oilseeds also shows an increasing trend except in the first three quinquennial periods. The highest decrease in area under oilseeds by 508 hectares (45.43

per cent) was recorded in the year 1955-60 followed by 122 hectares (20.00 per cent) in 1960-65. The highest increase in area under oilseeds was recorded in 1980-85, i.e. by 2,043 hectares (187.58 per cent). There is about 2,994 hectares (208.93 per cent) total increase in area under oilseeds between 1950-1990.

As against area, the production of cereals, pulses and oilseeds decreased by 32,196 metric tonnes (20.07 per cent), by 5,156 metric tonnes (11.91 per cent) and by 408 metric tonnes (62.67 per cent) in the first quinquennial period between 1950-55 respectively. In this period, the production of cash crops however, shows an increasing trend with an increase of 248,075 metric tonnes (9.78 per cent). From 1955-60 to 1980-85 the production of cereals, cash crops and oilseeds shows an increasing trend throughout. The highest increase, i.e. by 12,989 metric tonnes (64.50 per cent) in production under cereals was recorded in the years 1965-70, by 1,953,741 metric tonnes (23.13 per cent) under cash crops in 1980-85 and the highest increase in production under oilseeds was recorded by 1,499 metric tonnes (113.60 per cent) in the same period. There is an overall increase in the production of cereals, cash crops and oilseeds from 1950-90. It increased by 353,341 metric tonnes (220.28 per cent) under cereals, by 8,865,726 metric tonnes (349.81 per cent) under cash crops and by 2,375 metric tonnes (75.48 per cent) under oilseeds. The production of pulses shows

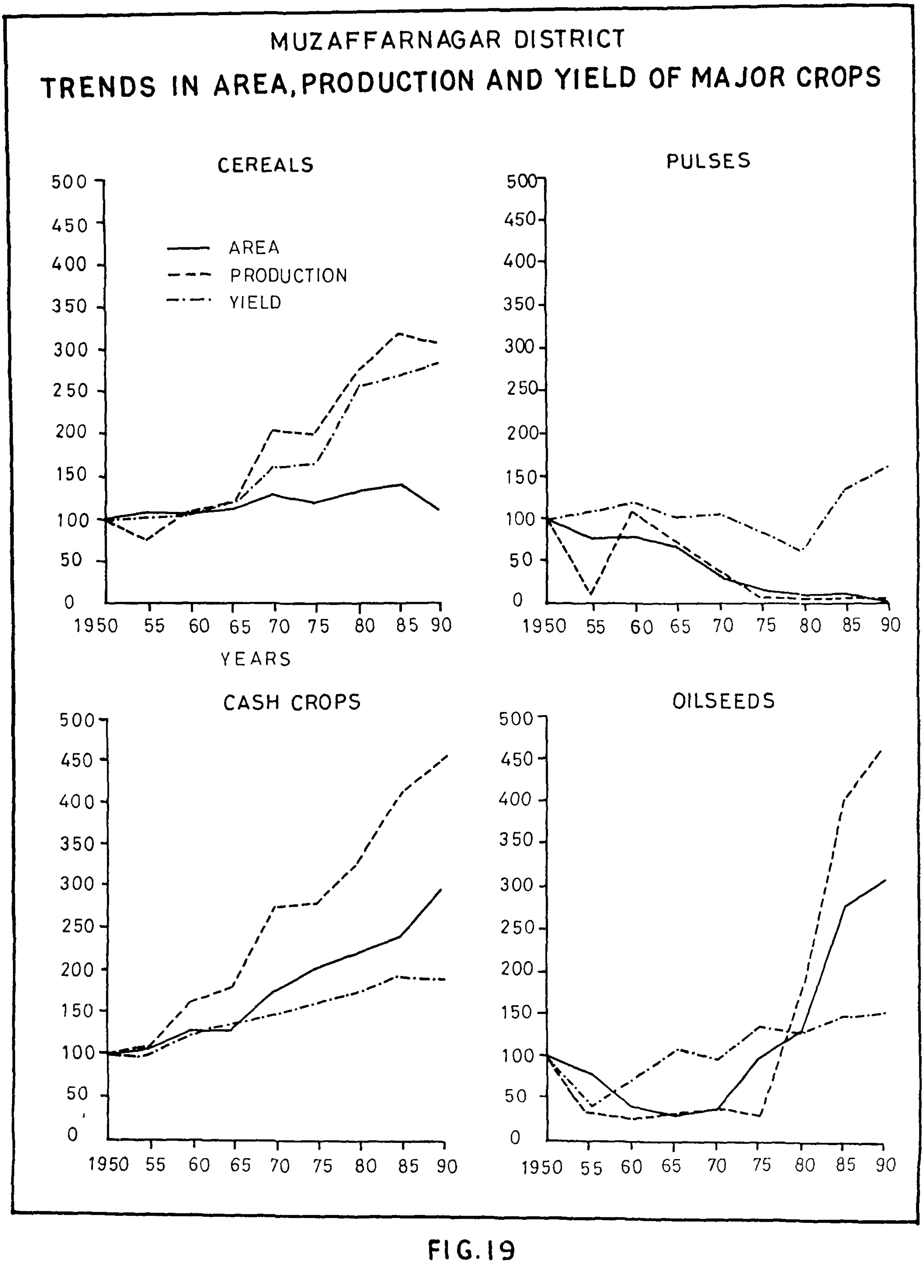

MUZAFFARNAGAR DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
YEARS
PULSES
CASH CROPS
OILSEEDS
500
450
400
350
300
250
200
150
100
50
0
1950
55
60
65
70
75
80
85
90

FIG.19

a decreasing trend except in two quinquennial periods. It increased by 6,504 metric tonnes (17.06 per cent) in 1955-60 and by 1,042 metric tonnes (25.34 per cent) in 1980-85. Otherwise, in other periods, the production decreased, the highest in the period of 1965-70 by 16,143 metric tonnes (48.50 per cent). The overall decrease in production under pulses is about 38,491 metric tonnes (88.92 per cent).

The yield of cereals shows a positive trend except in 1950-55 when it decreased by 2.24 quintals per hectare. The overall increase in yield under cereals is about 17.96 quintals per hectare (189.85 per cent). The yield of pulses shows a mixed trend. The maximum increase in yield in pulses, i.e. 5.12 quintals per hectare was recorded in the period of 1980-85. The maximum decrease in yield of 1.72 quintals per hectare (28.25 per cent) under pulses was observed in the period of 1975-80. But on the whole it shows an increase in yield by 4.30 quintals per hectare (64.08 per cent). The yield of cash crops shows an increasing trend except in 1985-90 when it decreased by 7.30 quintals per hectare (1.28 per cent). The overall increase in yield was about 226.09 quintals per hectare (68.09 per cent). The yield of oilseeds shows a mixed picture, but on the whole, there is an increase in its yield by 2.29 quintals per hectare (50.44 per cent).

6.2 Meerut

In the Meerut district all the crops show a declining trend in area and production while an upward trend in yield per hectare is shown by cereals and cash crops. As far as area alone is concerned, the distribution of cereal crops fluctuates from year to year. It increased by 14,993 hectares (5.30 per cent) in the first five years, i.e. from 1950-55 and then began to decline upto 1960-65, decreasing in ten years by 923 hectares (0.32 per cent). In another ten years from 1965 to 1975 it recorded an increase of 7,128 hectares (1.98 per cent). However it again decreased in the next fifteen years. The maximum decrease in cereals area was recorded in 1975-80 when it decreased by 141,114 hectares (38.48 per cent). The overall decrease in forty years is about 98,463 hectares (34.83 per cent).

The area under pulses also declined throughout all the periods except in the last quienquennial period. The maximum decrease of 37,873 hectares (41.91 per cent) was in the period 1965-70 and this decreasing trend continued upto 1980-85 when it decreased by about 2,651 hectares (29.81 per cent). But in the next period, i.e. in 1985-90 there was an increase of 289 hectares (4.63 per cent). In all the forty years the area under pulses decreased by about 118,545 hectares (94.77 per cent).

The area under cash crops on the other hand has consistently increased except in the period 1975-80 when it recorded a decrease by about 27,724 hectares (15.33 per cent). In the first twentyfive years the area under cash crops increased by 28,729 hectares (18.89 per cent). In the last ten years, the area under cash crops further increased by 10,300 hectares (6.50 per cent). In all the forty years, the increase was of the magnitude of 48,466 hectares (40.31 per cent).

The area under oilseeds reveals an interesting picture. In the first twenty years, the area under oilseeds decreased by 222 hectares (34.47 per cent) but in the last twenty years it compensated for the loss by an increase of 306 hectares (6.14 per cent). The overall increase in area under oilseeds is about 2,747 hectares (108.23 per cent).

The production of cereals shows a continuously increasing trend except in 1975-80 when it decreased by 83,500 metric tonnes (15.78 per cent). The increase in production of cereals was of 19,861 metric tonnes (12.90 per cent) in 1950-55, 2258 (0.86 per cent) metric tonnes in 1955-60, 19,123 metric tonnes (7.25 per cent) in 1960-65, 222,169 metric tonnes (78.62 per cent) the highest in all the periods 1965-70, and 24,319 metric tonnes in the next five years. In the last ten years it increased by 10,813 metric tonnes (1.91 per cent). The overall increase in production in forty years was 323,674 metric tonnes (139.91 per cent).

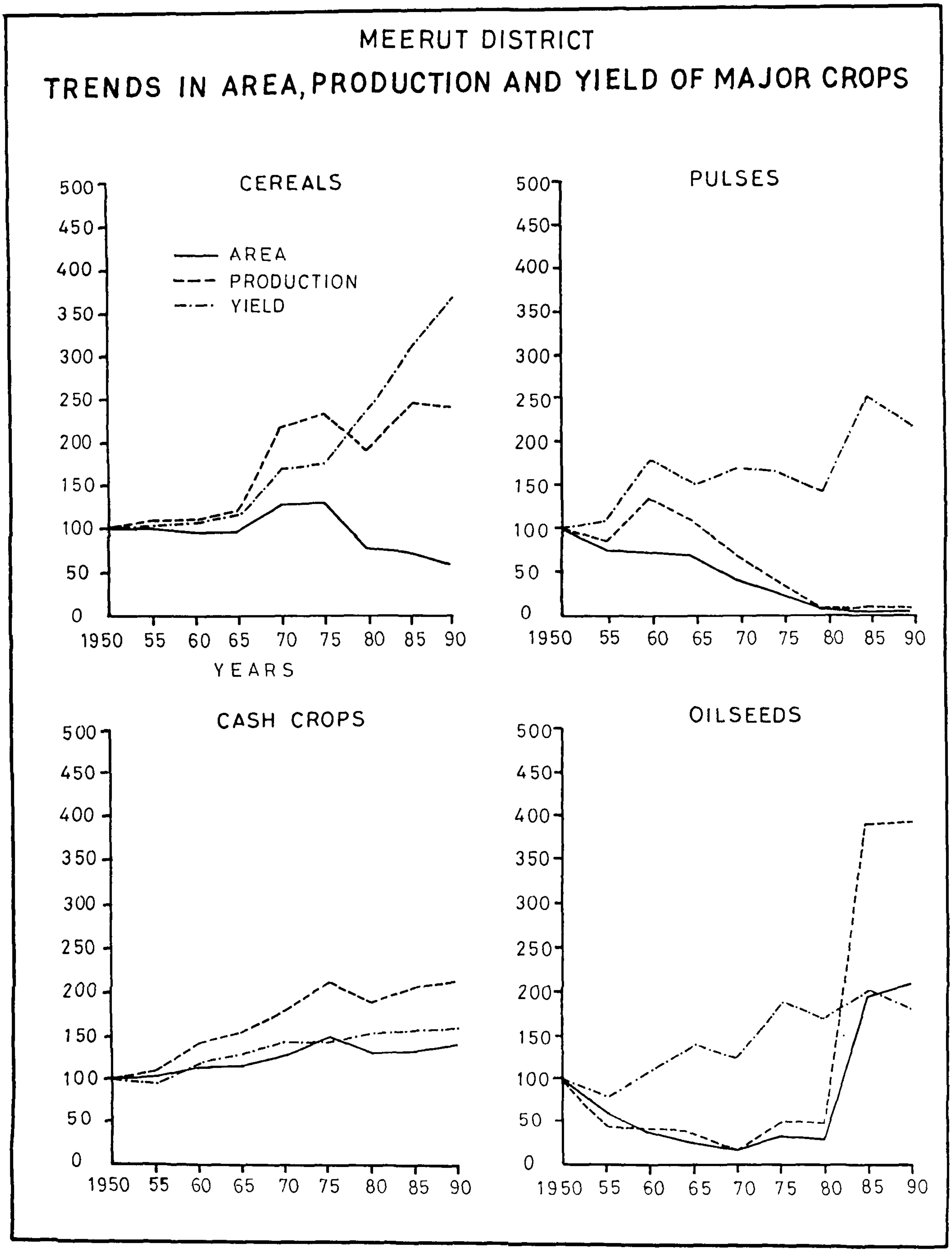

MEERUT DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
YEARS
PULSES
CASH CROPS
OILSEEDS
0
50
100
150
200
250
300
350
400
450
500
1950
55
60
65
70
75
80
85
90

FIG.20

The production of pulses declined in the first five years by 11,792 metric tonnes (17.04 per cent) but in the next five years, i.e. in 1955-60 it increased by 36,163 metric tonnes (63.00 per cent). From 1960-65 to 1975-80, the production of pulses recorded a declining trend. The maximum decrease in production of pulses was witnessed in the period 1965-70 when it declined by 26,546 metric tonnes (34.85 per cent). The period between 1980-85 shows an increase in production by 1,353 metric tonnes (18.48 per cent) but it again decreased in the next five years i.e. in 1985-90, by about 555 metric tonnes (6.29 per cent). In all the forty years under consideration, the production of pulses decreased by 61,067 metric tonnes (88.26 per cent).

The yield of cereals, pulses and cash crops shows an increasing trend while the yield of oilseeds recorded a fluctuating rate. All the crops however in forty years show a steady increase. The highest increase in yield was recorded in cereals among all the crops in forty years when it increased by 21.94 quintals per hectare (268.21 per cent). Pulses observed an increase of 6.90 quintals per hectare (124.77 per cent) in forty years, cash crops increased by 165.89 quintals per hectare (52.27 per cent) while oilseeds recorded an increase of 2.96 quintals per hectare (89.42 per cent) in forty years. The variations in area, production and yield is shown in Table XIII and its trend is given in Fig. 20.

TABLE XIII

Variations in area, production and yield of major crops in Meerut District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	14993	-12405	-923	75214	7128	-141114	-7937	-33419	-98463
		(5 30)	(-4 16)	(-0 32)	(26 45)	(1 98)	(-38 48)	(-3 51)	(-15 35)	(-34 83)
	P	29861	2258	19123	222169	24319	-83500	120257	10813	323674
		(12 90)	(0 86)	(7 25)	(78 62)	(4 81)	(-15 76)	(26 98)	(1 91)	(139 91)
	Y	0 59	0 46	0 70	4 10	0 39	5 33	6 24	4 13	21 94
		(7 21)	(5 24)	(7 58)	(41 28)	(2 77)	(36 96)	(31 59)	(15 89)	(268 21)
PULSES										
	A	-28394	-2861	-3459	-37873	-18814	-24782	-2651	289	-118545
		(-22 70)	(-2 95)	(-3 68)	(-41 91)	(-35 84)	(-73 59)	(-29 81)	(4 63)	(-94 77)
	P	-11792	36163	-17406	-26546	-19070	-23214	1353	-555	-61067
		(-17 04)	(63 00)	(18 60)	(-34 85)	(-38 44)	(-76 02)	(18 48)	(-6 39)	(-88 26)
	Y	0 40	4 04	-1 55	1 03	-0 39	-0 83	5 67	-1 47	6 90
		(7 23)	(68 12)	(-15 54)	(12 23)	(-4 12)	(-9 16)	(68 89)	(10 57)	(124 77)
CASH CROPS										
	A	4858	15306	396	11239	28729	-27724	5362	10300	48466
		(4 04)	(12 23)	(0 28)	(7 98)	(18 89)	(-15 33)	(3 50)	(6 50)	(40 31)
	P	117334	1432390	553577	818314	1486156	-833349	561898	210000	4346328
		(3 07)	(36 51)	(10 33)	(13 85)	(22 09)	(-10 14)	(7 61)	(2 64)	(114 07)
	Y	-3 75	67 85	38 25	22 80	11 89	27 85	19 17	18 17	165 89
		(-1 18)	(21 63)	(10 02)	(5 43)	(2 68)	(6 12))	(3 97)	(3 62)	(52 27)
OILSEEDS										
	A	-1100	-593	-201	-222	275	23	4259	306	2447
		(-43 34)	(-41 23)	(-23 78)	(-34 47)	(65 16)	(3 29)	(591 52)	(6 14)	(108 23)
	P	-463	-50	-22	-129	245	-15	2898	12	2476
		(-94 98)	(-13 19)	(-6 68)	(-42 01)	(137 64)	(-354)	(710 29)	(0 36)	(294 06)
	Y	-0 68	1 26	0 87	-0 55	1 85	-0 40	0 97	-0 36	2 96
		(-20 54)	(47 90)	(22 36)	(-11 55)	(43 94)	(-6 60)	(17 13)	(-5 42)	(89 42)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

6.3 Ghaziabad

The area under pulses and cereals has decreased in Ghaziabad district in the first five years from 1980-85. The decrease was to the extent of 5,446 hectares (3.00 per cent) under cereals and 1,884 hectares (18.84 per cent) under pulses. However the area under cash crops and oilseeds experienced an increasing trend upto an extent of 1,305 hectares (2.44 per cent) and 3,548 hectares (898.22 per cent) respectively. The area under cereals and pulses in the next five years, i.e. 1985-90 further recorded a decreasing trend upto 20,387 hectares (11.57 per cent) and 1,423 hectares (14.28 per cent) respectively. During the same period, the area under cash crops and oilseeds increased by 1,275 hectares (2.33 per cent) and by 812 hectares (20.59 per cent) respectively. The overall picture of the area under cereals and pulses, i.e. in all the years, shows a decreasing trend to the extent of 25,833 hectares (14.23 per cent) and 3,307 hectares (27.92 per cent) respectively. Cash crops and oilseeds in all the ten years have increased in their extent respectively by 2,580 hectares (4.84 per cent) and by 4,360 hectares (1103.79 per cent).

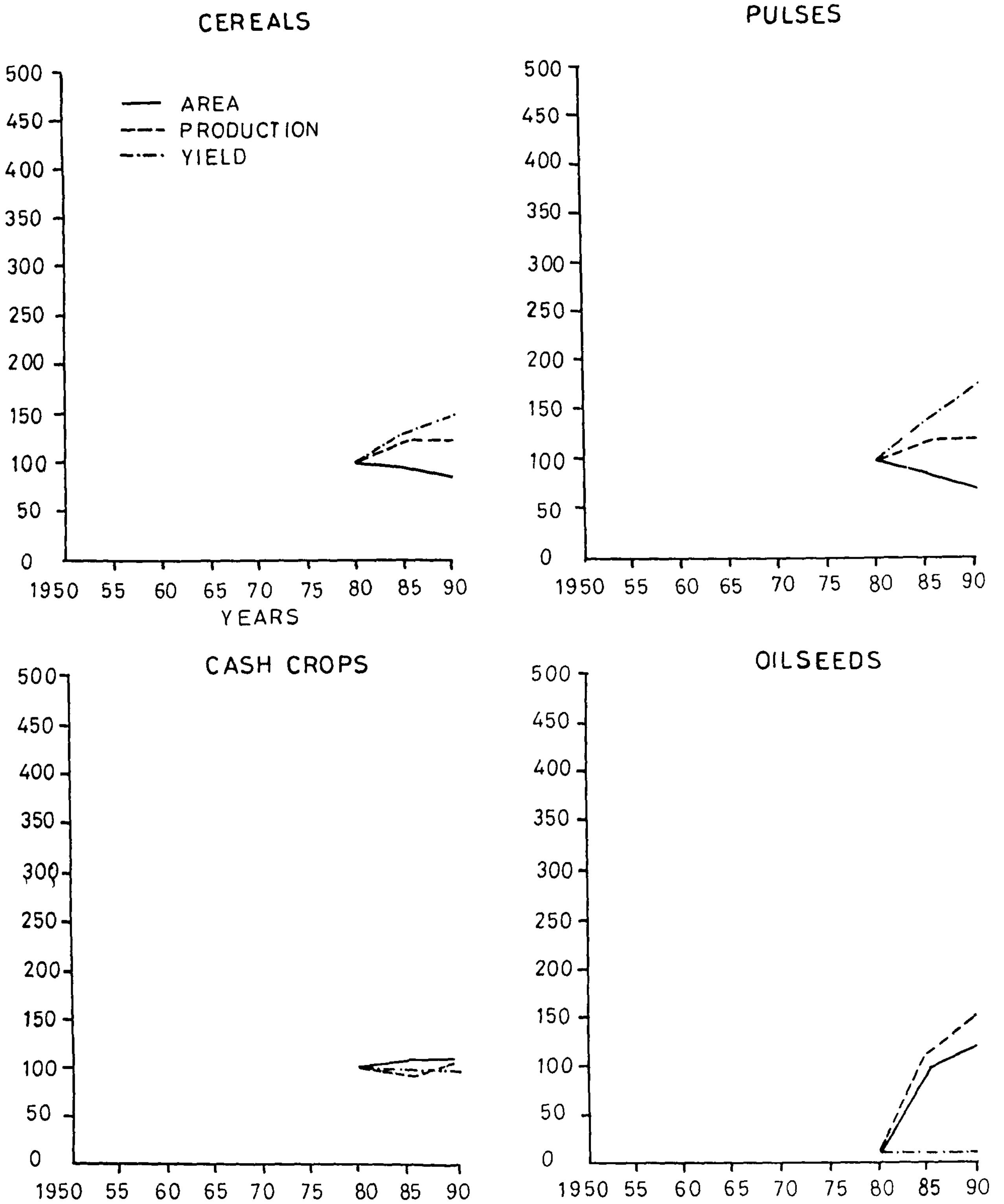
The production of cereals in the first five years, i.e. in 1980-85 on the other hand increased by 75,682 metric tonnes (23.12 per cent) but in the next five years it decreased by 4,294 metric tonnes (1.06 per cent). The production of pulses shows a steady increase. It increased by 1,950 metric tonnes

(20.08 per cent) in the first quinquennial period and by 104 metric tonnes (0.89 per cent) in the next five years, i.e. in 1985-90. The production under cash crops decreased by 122,923 metric tonnes (4.70 per cent) but the production of oilseeds increased by 2,396 metric tonnes (1084.16 per cent) in the first five years. In the next quinquennial period the production of cash crops and oilseeds have increased by 132,053 metric tonnes (5.30 per cent), and 702 metric tonnes (26.82 per cent) respectively. In all the ten years the production of cereals, pulses, cash crops and oilseeds recorded an increase of 71,368 metric tonnes (21.89 per cent), 2,054 metric tonnes (21.15 per cent), 9,130 metric tonnes (0.34 per cent) and 3,098 metric tonnes (1401.8 per cent) respectively.

As far as yield is concerned, it shows a steady increase in cereals, pulses and oilseeds while cash crops show a declining trend. In the first five years, i.e. from 1980 to 1985, the yield of cereals increased by 4.86 quintals per hectare (27.07 per cent) and by 2.71 quintals per hectare (11.89 per cent) in the next quinquennial period. The yield of pulses exhibits an increasing trend to the extent of 3.51 quintals per hectare (42.85 per cent) in the first five years and 2.08 quintals per hectare (17.77 per cent) in the next quinquennial period. The yield of cash crops during 1980-85 recorded a decreasing trend upto 34.25 quintals per hectare (6.98 per cent) but it increased in 1985-90 by 13.23 quintals per hectare (2.89

GHAZIABAD DISTRICT

TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS



GHAZIABAD WAS FORMED AS AN INDEPENDENT DISTRICT IN 1976-77

FIG·21

TABLE XIV

Variations in area, production and yield of major crops in Ghaziabad District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A							-5446	-20387	-25833
								(-3 00)	(-11 57)	(-14 23)
	P							75682	-4294	71388
								(23 21)	(-1 06)	(21 89)
	Y							4 86	2.71	7 57
								(27.07)	(11 88)	42 17)
PULSES										
	A							-1884	-1423	-3307
								(-18.84)	(-14 28)	(-27 92)
	P							1950	104	2054
								(20.08)	(0 89)	(21 15)
	Y							3 51	2 08	5 59
								(42 85)	(17 77)	(68 25)
CASH CROPS										
	A							1305	1275	2580
								(2 44)	(2.33)	(4 84)
	P							-122923	132053	9130
								(-4 70)	(5 30)	(0 34)
	Y							-34 25	13 23	-21 02
								(-6.98)	(2 89)	(-4 28)
OILSEEDS										
	A							3548	812	4360
								(898.22)	(20 59)	(1103 79)
	P							2396	702	3098
								(1084 16)	(26 82)	(1401 80)
	Y							1 07	0 32	1 39
								(19.14)	(4 80)	(24 86)

A = Area

P = Production

Y = Yield

Note: Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years per cent). The yield of oilseeds has increased by 1.07 quintals per hectare (19.14 per cent) in 1980-85 and 0.32 quintals per hectare (4.80 per cent) in the next five years i.e. in 1985-90. The crops like cerals, pulses and oilseeds in all the ten years show an increasing trend by the magnitude of 7.57 quintals per hectare (42.17 per cent), 5.59 quintals per hectare (68.25 per cent) and 1.39 quintals per hectare (24.86 per cent) respectively while the yield of cash crops shows a decrease of 21.02 quintals per hectare (4.28 per cent) in the same period. The variations in area, production and yield is given in Table XIV and its trends is shown in Fig. 21.

6.4 Bulandshahr

Cropped area and production of crops both fluctuate in time in Bulandshahr. During the first five years, i.e. from 1950 to 1955, the area under cereals increased by 37,276 hectares (12.77 per cent), the area under pulses decreased by 33,313 hectares (33.33 per cent), while the area under cash crops decreased by 1,100 hectares (1.91 per cent) and the area under oilseeds decreased by 2,273 hectares (50.36 per cent). In the next five years in 1955-60, the area under cereals and oilseeds further decreased by 42,186 hectares (12.82 per cent) and 1,013 hectares (45.22 per cent) respectively. The area under pulses and cash crops however, increased by 22,660 hectares (34.00 per cent) and 11,067 hectares (19.68 per cent) respectively in the same period. In the next quinquennial period in 1960-65, the area under cereals, pulses and oilseeds increased by 15,434 hectares (5.38 per cent) by 6,366 hectares (7.12 per cent) and by 389 hectares (31.70 per cent) respectively, but the area under cash crops decreased by 505 hectares (7.12 per cent) during the same period. The highest increase in area under cereals was recorded in 1965-70. In this period it increased by 86,663 hectares (28.66 per cent). In the same period the area under pulses, cash crops and oilseeds decreased by 38,255 hectares (39.99 per cent), by 16,198 hectares (24.25 per cent) and by 85 hectares (5.25 per cent) respectively. In the next ten years i.e. in 1970-75 and 1975-80 the area under pulses decreased but the area under cash crops and oilseeds increased. The area under cereals in the period 1970-75 increased by 13,456 hectares (3.45 per cent) but in the next five years it decreased by 12,200 hectares (3.03 per cent). In the last five years i.e. in 1985-90, the area under cereals increased by 51,500 hectares (14.10 per cent), the area under pulses decreased by 299 hectares (1.34 per cent), the area under cash crops increased by 5,183 hectares (9.37 per cent) and the area under oilseeds increased by 2,106 hectares (10.93 per cent). In all the forty years, the area under cereals, cash crops and oilseeds increased by 124,925 hectares (42.81 per cent), by 3,145 hectares (5.48 per cent) and by 16,847 hectares (373.29 per cent) respectively, while the area under pulses decreased by 78,017 hectares (1.34 per cent).

The production of cereals and cash crops increased 47,810 metric tonnes (20.88 per cent) and 179,683 metric tonnes (10.64 per cent) in the first five years respectively, while the production of pulses and oilseeds decreased by 31,585 metric tonnes (41.59 per cent) and by 1,323 metric tonnes (71.98 per cent) respectively. In the next quinquennial period i.e. 1955-60, the production of cereals and oilseeds exhibits a decreasing trend to the extent of 20,793 metric tonnes (7.51 per cent) and 13 metric tonnes (2.52 per cent) respectively while the production of pulses and cash crops, exhibits an increasing trend to the extent of 48,341 metric tonnes (108.91 per cent) and 557,894 metric tonnes (29.86 per cent). During the period of 1960-65, the production of cereals shows an increasing trend of the magnitude of 27,922 metric tonnes (70.90 per cent), pulses and cash crops show a decreasing trend of the magnitude of 8,784 metric tonnes (9.47 per cent) and by 56,329 metric tonnes (2.32 per cent) respectively. The production of oilseeds during the same period increased by 251 metric tonnes (50.00 per cent). The production of cereals and pulses in the next five years in 1965-70 experienced an increase of 297,917 metric tonnes (104.94 per cent) and 81,603 metric tonnes (97.21 per cent) respectively. The production of cash crops and oilseeds experienced a decrease of 614,526 metric tonnes (25.93 per cent) and 157 metric tonnes (20.84 per cent) respectively, in the same period. In the next quinquennial period, i.e. 1970-75, the production of cereals and pulses reduced by 30,665 metric tonnes (5.27 per cent) and 129,295 metric tonnes (78.28 per cent) respectively, while the production of cash crops and oilseeds increased by 594,208 metric tonnes (33.86 per cent) and 1,627 metric tonnes (272.98 per cent) respectively. The production of cereals, cash crops and oilseeds show an increasing trend upto the extent of 172,129 metric tonnes (31.23 per cent), 489,807 metric tonnes (20.82 per cent) and 146 metric tonnes (6.56 per cent) respectively. The production of pulses in the same period reduced by 16,764 metric tonnes (46.24 per cent). At the final stages in 1985-90, the production under cereals, cash crops and oilseeds experience an increase upto an extent of 121,731 metric tonnes (12.58 per cent), 490,060 metric tonnes (20.21 per cent), 1,000 metric tonnes (7.80 per cent) respectively. While the pulses production decreased by 1,419 metric tonnes (5.83 per cent). In all the forty years of study the production under cereals, cash crops and oilseeds shows an increasing trend upto an extent of 860,047 metric tonnes (375.64 per cent), 1,226,093 metric tonnes (72.63 per cent) and 11,976 metric tonnes (651.57 per cent) respectively, while the production of pulses in the same period decreased by 53,021 metric tonnes (69.81 per cent).

There is an overall increase in the yield of all the crops of the district. In the forty years the yield of cereals, pulses, cash crops and oilseeds increased by 18.29 quintals per hectare (233.29 per cent), 2.86 quintals per

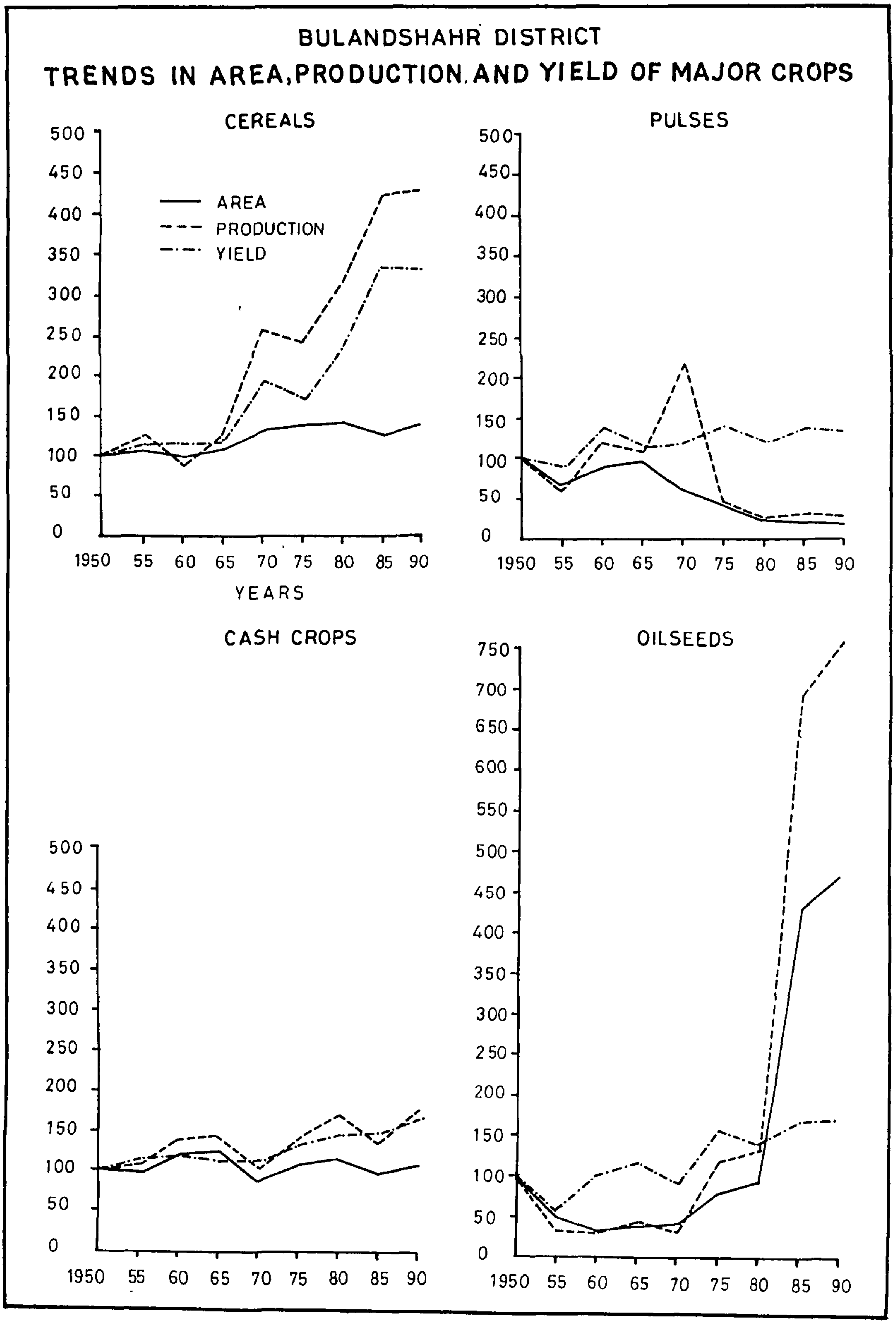

BULANDSHAHR DISTRICT
TRENDS IN AREA, PRODUCTION, AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
500
450
400
350
300
250
200
150
100
50
0
1950
55
60
65
70
75
80
85
90
YEARS
PULSES
CASH CROPS
OILSEEDS
750
700
650
600
550

FIG.22

TABLE XV

Variations in area, production and yield of major crops in Bulandshahr District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	37276	-42186	15434	86663	13456	-12200	-25015	51500	124925
		(12 77)	(-12 82)	(5 38)	(28 66)	(3 45)	(-3 03)	(-6 41)	(14 10)	(42 81)
	P	47810	-20793	27922	297917	-30665	172129	243996	121731	860047
		(20 88)	(-7 51)	(10 90)	(104 94)	(-5 27)	(31 23)	(33 73)	(12 58)	(375 64)
	Y	0 57	0 45	0 53	5 56	-1 26	4 85	7 95	0 35	18 29
		(7 27)	(5 35)	(5 98)	(59 21)	(-8 42)	(35 42)	(42 90)	(-1 32)	(233 29)
PULSES										
	A	-33313	22660	6366	-38255	-24037	-11675	536	-299	-78017
		(-33 33)	(34 00)	(-7 12)	(-39 99)	(-41 87)	(-34 98)	(2 47)	(-1 34)	(-78 05)
	P	-31585	48341	-8784	81603	-129295	-16764	4855	-1419	-53021
		(-41 59)	(108 91)	(-9 47)	(97 21)	(-78 28)	(-46 24)	(24 91)	(-5 83)	(-69 81)
	Y	-0 93	3 72	-1 61	0 06	2 03	-1 88	1 95	-0 49	2 86
		(-12 25)	(55 85)	(-15 51)	(0 68)	(22 98)	(-17 31)	(21 82)	(-4 47)	(37 68)
CASH CROPS										
	A	-1100	11067	-505	-16198	9680	5123	-10105	5183	3145
		(-1 91)	(19 68)	(-0 75)	(-24 25)	(19 13)	(8 50)	(-15 45)	(9 37)	(5 48)
	P	179683	557894	-56329	-614526	594208	489807	-417704	490060	1226093
		(10 64)	(29 86)	(-2 32)	(-25 93)	(33 86)	(20 82)	(-14 69)	(20 21)	(72 63)
	Y	37 72	28 27	-5 71	-7 88	43 37	44 33	3 88	43 46	187 44
		(12 80)	(8 50)	(-1 58)	(-2 22)	(12 50)	(11 35)	(0 89)	(9 91)	(29 69)
OILSEEDS										
	A	-2273	-1013	389	-85	2073	507	15143	2106	16847
		(-50 36)	(-45 22)	(31 70)	(-5 25)	(135 40)	(14 06)	(368 35)	(10 93)	(373 29)
	P	-1323	-13	251	-157	1627	146	10445	1000	11976
		(-71 98)	(-2 52)	(50 00)	(-20 84)	(272 98)	(6 56)	(440 90)	(7 80)	(651 57)
	Y	-1 78	1 80	0 56	-0 76	2 27	-0 40	0 89	-0 19	2 39
		(-43 73)	(78 60)	(13 69)	(-16 34)	(58 35)	(-6 49)	(15 45)	(-2 85)	(58 72)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

hectare (37.68 per cent), 187.44 quintals per hectare (29.69 per cent) and 2.39 quintals per hectare (58.72 per cent) respectively. The variation in area, production and yield is given in Table XV and its trends is shown in Fig. 22.

6.5 Aligarh

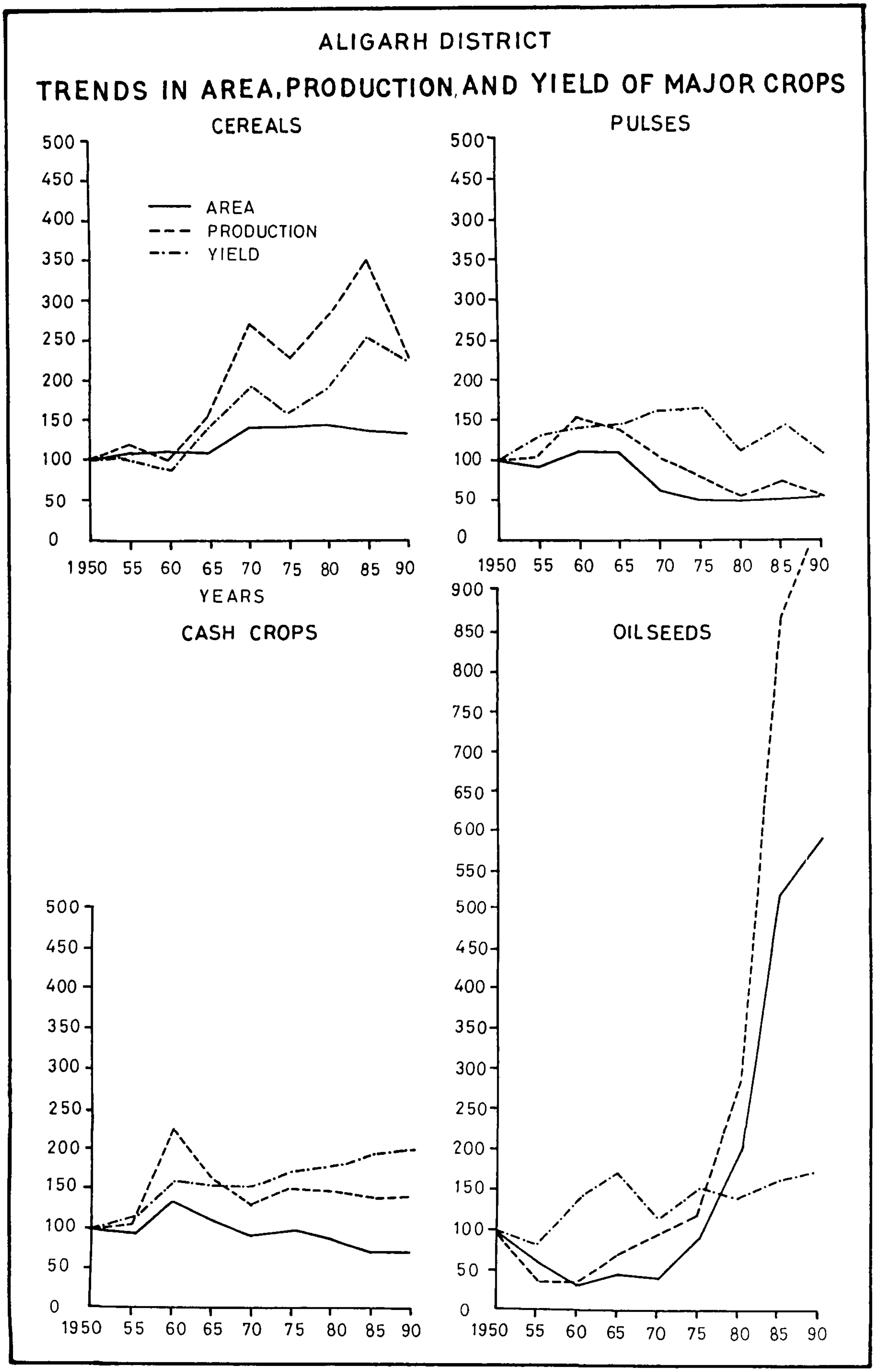
The area under cereals in Aligarh district decreased in twenty years out of forty years. In the first five years, i.e. in 1950-55, the area under cereals increased by 40,264 hectares (13.13 per cent). The highest increase in area under cereals was noticed in the period 1965-70 when it went up by 103,128 hectares (31.15 per cent) followed in the next five years by 21,068 hectares (4.85 per cent). The lowest increase in area under cereals was recorded in the period 1960-65 when it increased by only upto 14,895 hectares (4.71 per cent). The highest decrease in area under cereals with 30,651 hectares (8.83 per cent) was noticed in 1955-60. The lowest decrease in area under cereals was seen in the period 1975-80 when it decreased by 2,839 hectares (99.37 per cent). The areal extent of pulses, cash crops and oilseeds shows a decreasing trend in the first five years during 1950-55 decreasing by 21,974 hectares (18.46 per cent), 1,482 hectares (5.90 per cent) and 3,955 hectares the highest (47.76 per cent) respectively. The highest decrease in area was 50,687 hectares (40.90 per cent) for pulses in 1965-70, 8,786 hectares (25.03 per cent) in 1960-65 for cash crops and 3955 hectares (47.76 per cent) in

1950-55 for oilseeds. The minimum decrease in area under these crops was 94 hectares (0.15 per cent) under pulses in 1980-85, 381 hectares (2.06 per cent) under cash crops in 1985-90 and 771 hectares (20.81 per cent) under oilseeds in 1965-70. The maximum increase in area under pulses, cash crops and oilseeds was 32,771 hectares (33.77 per cent) in 1955-60, 11,462 hectares (48.50 per cent) in 1955-60 and 27,172 hectares (168.86 per cent) in 1980-85 respectively. In all the forty years, pulses and cash crops have decreased in area by 57,297 hectares (48.14 per cent) and 7,041 hectares (28.03 per cent) respectively while the area under oilseeds increased upto an extent of 40,054 hectares (483.74 per cent).

The highest increase in production under cereals was 277,911 metric tonnes (74.44 per cent) in 1965-70, pulses 43,024 metric tonnes (44.60 per cent) in 1955-60, cash crops 540,410 metric tonnes (112.85 per cent) in 1955-60 and oilseeds 21,371 metric tonnes (205.98 per cent) in 1980-85. The lowest increase in the production under cereals, pulses, cash crops and oilseeds was recorded as 45,548 metric tonnes (18.95 per cent) in 1950-55, 3,152 metric tonnes (3.45 per cent) in 1950-55, 741 metric tonnes (0.11 per cent) in 1985-90 and 1,381 metric tonnes (100.50 per cent) in 1960-65 respectively. The maximum decrease in the production under cereals was seen in 1985-90 when it decreased by 285,653 metric tonnes (33.95 per cent), under pulses it was noticed in the year 1965-70 when it decreased by

39,494 metric tonnes (30.16 per cent), under cash crops the maximum decrease in the production was recorded as 286,356 metric tonnes (28.09 per cent) in 1960-65 and under oilseeds, the maximum decrease was noticed as 2,120 metric tonnes (57.18 per cent) in 1950-55. The lowest decrease in production under cereals, pulses, cash crops and oilseeds was obtained as 45,427 metric tonnes (15.89 per cent) in 1955-60, 6,447 metric tonnes (4.69 per cent) in 1960-65, 67,910 metric tonnes (11.45 per cent) in 1980-85 and 213 metric tonnes (13.42 per cent) in 1955-60 respectively. In all the forty years, the production of cereals, cash crops and oilseeds respectively increased by 318,408 metric tonnes (132.51 per cent), 188,388 metric tonnes (40.79 per cent) and 32,915 metric tonnes (887.91 per cent) while the production of pulses in the same period decreased by 40,047 metric tonnes (43.92 per cent).

In the first quinquennial period of 1950-55, the yield of cereals, pulses and cash crops show an increasing trend except oilseeds of which the yield decreased by 0.81 quintals per hectare (18.12 per cent). In the next quinquennial period the yield of pulses, cash crops and oilseeds increased whereas the yield of cereals decreased by 0.64 quintals per hectare (7.75 per cent). The maximum increase in yield under cereals was noticed in 1980-85 with an increase of 4.74 quintals per hectare (31.57 per cent). The highest decrease in yield under cereals of 6.00 quintals per hectare (30.37 per cent) was recorded in



ALIGARH DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
500
450
400
350
300
250
200
150
100
50
0
1950 55 60 65 70 75 80 85 90
YEARS
PULSES
500
450
300
350
300
250
200
150
100
50
0
1950 55 60 65 70 75 80 85 90
CASH CROPS
500
450
400
350
300
250
200
150
100
50
0
1950 55 60 65 70 75 80 85 90
OILSEEDS
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
1950 55 60 65 70 75 80 85 90

FIG-23

TABLE XVI

Variations in area, production and yield of major crops in Aligarh District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	40264	-30651	14895	103128	21068	-2839	-26547	-19646	99672
		(13 13)	(-8 83)	(4 71)	(31 15)	(4 85)	(-99 37)	(-5 86)	(-4 61)	(32 51)
	P	45548	-45427	132913	277911	-85612	113537	162191	-285653	318408
		(18 95)	(-15 89)	(55 28)	(74 44)	(-13 14)	(20 07)	(23 88)	(-33 95)	(132 51)
	Y	0 41	-0 64	3 67	3 72	-2 57	2 59	4 74	-6 00	5 92
		(5 23)	(-7 76)	(47 89)	(33 00)	(-17 14)	(20 85)	(31 57)	(-30 37)	(75 60)
PULSES										
	A	-21974	32771	-5886	-50687	-14785	680	-94	2680	-57297
		(-18 46)	(33 77)	(-17 86)	(-40 90)	(-20 18)	(1 16)	(-0 15)	(4 53)	(-48 14)
	P	3152	43024	-6447	-39494	-20301	-19687	13027	-13327	-40047
		(3 45)	(45 60)	(-4 69)	(-30 16)	(-22 20)	(-27 68)	(25 33)	(-20 66)	(-43 92)
	Y	2 06	0 86	-0 02	1 92	-0 32	-3 47	2 22	-2 63	0 62
		(26 89)	(8 84)	(-0 18)	(18 18)	(-2 56)	(-28 53)	(25 54)	(-24 10)	(8 09)
CASH CROPS										
	A	-1482	11462	-8786	-4579	520	-2549	-1246	-381	-7041
		(-5 90)	(48 50)	(-25 03)	(-17 40)	(2 39)	(-11 45)	(-6 32)	(-2 06)	(-28 03)
	P	17003	540410	-286356	-128584	102005	-67910	11079	741	188388
		(3 68)	(112 85)	(-28 09)	(-17 54)	(16 87)	(-9 61)	(1 73)	(0 11)	(40 79)
	Y	18 73	87 81	-12 61	0 30	39 35	6 61	27 89	7 83	175 91
		(10 18)	(43 39)	(-4 34)	(0 10)	(14 14)	(2 08)	(8 60)	(2 22)	(95 65)
OILSEEDS										
	A	-3955	-2202	1581	-771	3850	9308	27172	5071	40054
		(-47 76)	(-50 91)	(74 47)	(-20 81)	(131 26)	(137 22)	(168 86)	(11 72)	(483 74)
	P	-2120	213	1381	-1249	3088	5781	21371	4876	32915
		(-57 18)	(-13 42)	(100 50)	(-45 33)	(204 04)	(125 83)	(205 98)	(15 35)	(887 91)
	Y	-0 81	2 81	0 96	-2 30	1 64	-0 33	0 89	0 27	3 10
		(-18 12)	(76 77)	(14 83)	(-30 95)	(31 96)	(-4 87)	(13 81)	(3 68)	(69 35)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

1985-90. The highest increase in yield of pulses was 2.22 quintals per hectare (25.54 per cent) in 1980-85, while that of cash crops highest increase in 1955-60 with 87.81 quintals per hectare (43.33 per cent). For oilseeds, the highest increase in yield was 2.81 quintals per hectare (76.77 per cent) obtained in 1955-60. The highest decrease in yield under pulses, cash crops and oilseeds was 3.47 quintals per hectare (28.53 per cent) in 1975-80, 12.61 quintals per hectare (4.34 per cent) in 1960-65 and 2.30 quintals per hectare (30.95 per cent) in 1965-70 respectively. In all the forty years under consideration, the yield of all the four crops, namely, cereals, pulses, cash crops and oilseesds revealed an increasing trend. The variations in area, production and yield is given in Table XVI and its trends is shown in Fig. 23.

6.6 Mathura

The area under cereals in Mathura district has been fluctuating during the period under study but their production recorded a continous increase except one break. The highest increase in area under cereals was of 60,090 hectares (27.90 per cent) in 1965-70. In the same period, the production of cereals also had highest increase of 139,382 metric tonnes (67.90 per cent). The least increase in area under cereals was 5,958 hectares (1.99 per cent) in 1975-80 whereas the lowest increase in production of cereals was 18,182 metric tonnes (5.27 per cent) in 1970-75. The highest decrease in area under cereals was 36,351 hectares (13.11 per cent) in 1985-90 and the highest decrease in production under cereals was 2,013 metric tonnes (1.22 per cent) in 1955-60. The highest increase in area under pulses, cash crops and oilseeds was 12,653 hectares (14.54 per cent) in 1955-60, 7,276 hectares (46.19 per cent) in 1955-60 and 24,278 hectares (122.46 per cent) in 1980-85 respectively. The highest increase in production under pulses, cash crops and oilseeds was noticed as 18,371 metric tonnes (24.34 per cent) in 1955-60, 349,998 metric tonnes (97.65 per cent) in 1955-60, and 25,153 metric tonnes (192.97 per cent) in 1980-85 respectively. The highest decrease in area under pulses, cash crops and oilseeds was 39,311 hectares (39.74 per cent) in 1965-70, 5,245 hectares (22.90 per cent) in 1965-70 and 8,282 hectares (32.85 per cent) in 1950-55 respectively. The highest decrease in production under pulses, cash crops and oilseeds was respectively 50,294 metric tonnes (59.01 per cent) in 1970-75, 353,035 metric tonnes (35.03 per cent) in 1965-70 and 4,852 metric tonnes (47.38 per cent) in 1950-55. In all the forty years the area under cereals and oilseeds increased while the area under pulses and cash crops decreased. The overall increase in area under cereals was 53,307 hectares (28.41 per cent) and under oilseeds it was 22,850 hectares (90.63 per cent). The total decrease in area in all the forty years under pulses was 81,380 hectares (87.28 per cent) while cash crops decreased by 4,420 hectares (24.20 per cent). The production in all the forty years has increased under cereals, cash crops and oilseeds by 414,201 metric tonnes (308.21 per cent), 14,634 metric tonnes (28.98 per cent) and 32,395 metric tonnes (316.35 per cent) respectively while the production under pulses decreased by 9,682 metric tonnes (85.43 per cent) in the same period.

The yield of all the crops in all the eight periods of time shows a fluctuating trend. In the first twenty years the yield per hectare shows an increasing trend while it decreased by 0.34 quintals per hectare (2.71 per cent) in the next five years i.e. in 1970-75. But it again shows a rising trend in the next ten years. In all the forty years the yield of cereals per hectare rose upto 15.61 quintals per hectare (218.01 per cent). The yield of pulses also shows a rising trend in the first twenty years. But in the next five years it decreased by 5.53 quintals per hectare (38.67 per cent) followed by 1.52 quintals per hectare (17.33 per cent) in the other five years. In the last ten years, it again shows an upward trend. The highest increase in yield under pulses was 4.30 quintals per hectare (43.00 per cent) in 1975-70. In all the forty years the yield of pulses increased by 3.29 quintals per hectare (52.47 per cent). The yield under cash crops however, shows a fluctuating trend. The maximum increase was 136.92 quintals per hectare (45.15 per cent) in 1960-65 while the maximum decrease was 69.22 quintals per hectare (15.72 per cent) in 1965-70. In all the forty years, the yield increased by 151.97 quintals per

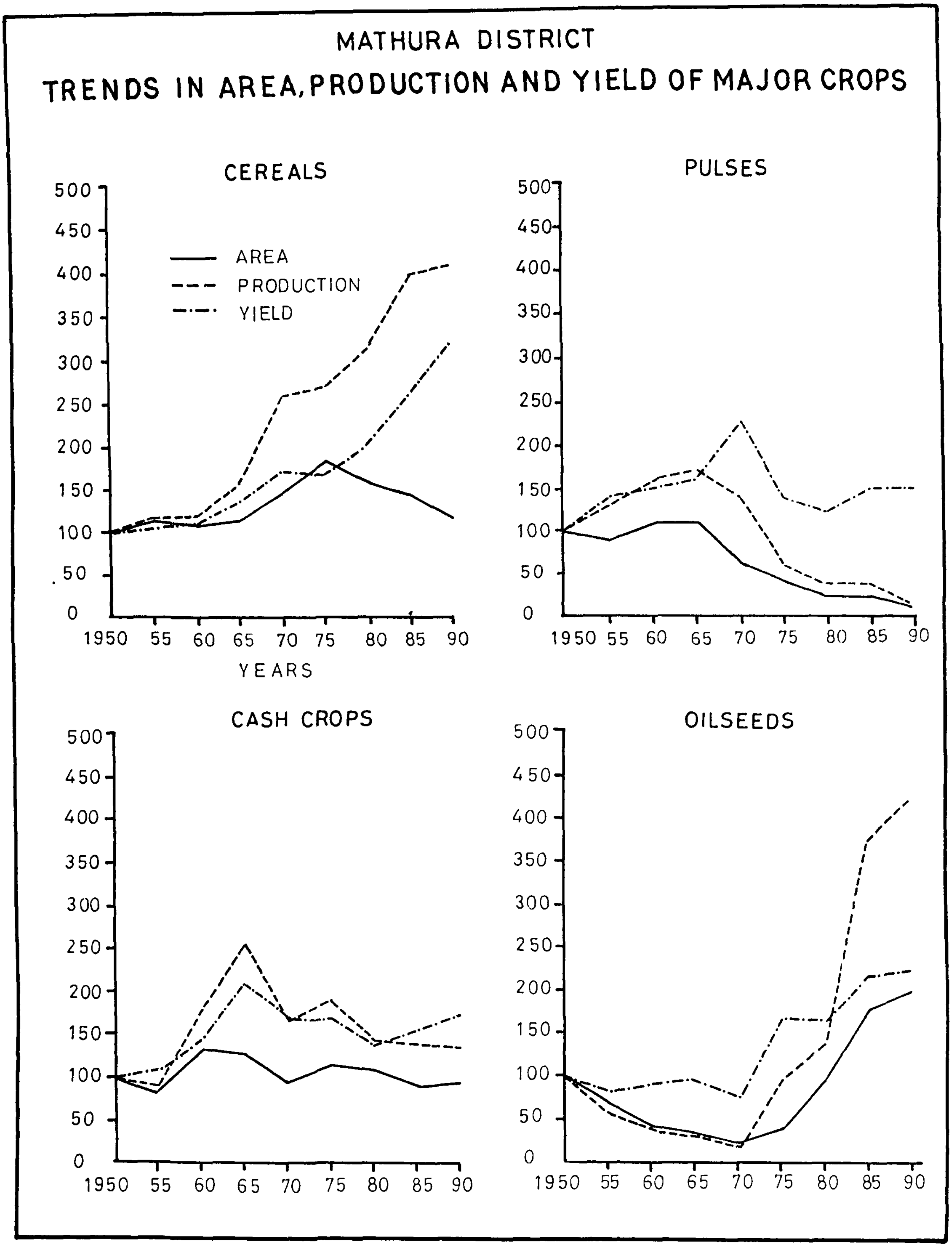

MATHURA DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
500
450
400
350
300
250
200
150
100
50
0
1950
55
60
65
70
75
80
85
90
YEARS
PULSES
CASH CROPS
OILSEEDS

FIG.24

TABLE XVII

Variations in area, production and yield of major crops in Mathura District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950 90
CEREALS										
	A	29235	-11464	9972	60090	22608	-5958	-14825	-36351	53307
		(15 58)	(-5 28)	(4 85)	(27 90)	(8 20)	(-1 99)	(-5 07)	(-13 11)	(28 41)
	P	29547	-2013	43270	139382	18182	58608	109246	18979	414201
		(21 98)	(-1 22)	(26 72)	(67 90)	(5 27)	(16 15)	(24 74)	(3 58)	(308 21)
	Y	0 40	0 32	1 69	2 94	-0 34	2 25	4 68	3 67	15 61
		(5 58)	(4 23)	(21 44)	(30 72)	(-2 71)	(18 48)	(32 45)	(19 21)	(218 01)
PULSES										
	A	-6212	12653	-773	-39311	-1[illegible]772	-11984	-5714	-10267	-81380
		(-6 66)	(14 54)	(-0 77)	(-39 74)	(-33 17)	(-30 09)	(-20 52)	(-46 41)	(-87 28)
	P	16992	18371	5096	-13706	-50294	-13343	-570	-9682	-9682
		(29 06)	(24 34)	(5 43)	(-13 85)	(-59 01)	(-38 20)	(-20 52)	(-46 41)	(-87 28)
	Y	2 40	0 74	0 59	4 30	-5 53	-1 52	1 75	0 06	3 29
		(38 27)	(8 53)	(6 26)	(43 00)	(-38 67)	(-17 33)	(22 58)	(0 63)	(52 47)
CASH CROPS										
	A	-2512	7276	-133	-5245	2646	-1452	-2668	-2332	-4420
		(-13 75)	(46 19)	(-0 57)	(-22 90)	(14 99)	(-7 15)	(-14 15)	(-14 41)	(-24 20)
	P	-42291	344998	309438	-353035	61666	-167556	-12793	-25793	114634
		(-1 06)	(97 65)	(44 31)	(-35 03)	(9 41)	(-23 39)	(-2 33)	(-4 81)	(28 98)
	Y	7 70	78 95	136 92	-69 22	-17 98	-61 72	40 13	37 19	151 97
		(3 55)	(35 20)	(45 15)	(-15 72)	(-4 84)	(-17 48)	(13 77)	(11 22)	(70 16)
OILSEEDS										
	A	-8282	-7126	-1582	-2586	4501	9689	24278	3958	22850
		(-32 85)	(-42 09)	(-16 13)	(-31 45)	(79 87)	(95 58)	(122 46)	(8 97)	(90 63)
	P	-4852	-1934	-286	-1465	5194	6137	25153	4448	32395
		(-47 38)	(-35 89)	(-8 28)	(-46 30)	(304 99)	(88 98)	(192 97)	(11 64)	(316 65)
	Y	-0 88	0 34	0 33	-0 85	3 78	-0 23	2 08	0 22	4 81
		(-21 67)	(10 69)	(9 37)	(-22 07)	(125 16)	(-3 38)	(31 65)	(2 54)	(118 47)

A = Area

P = Production

Y = Yield

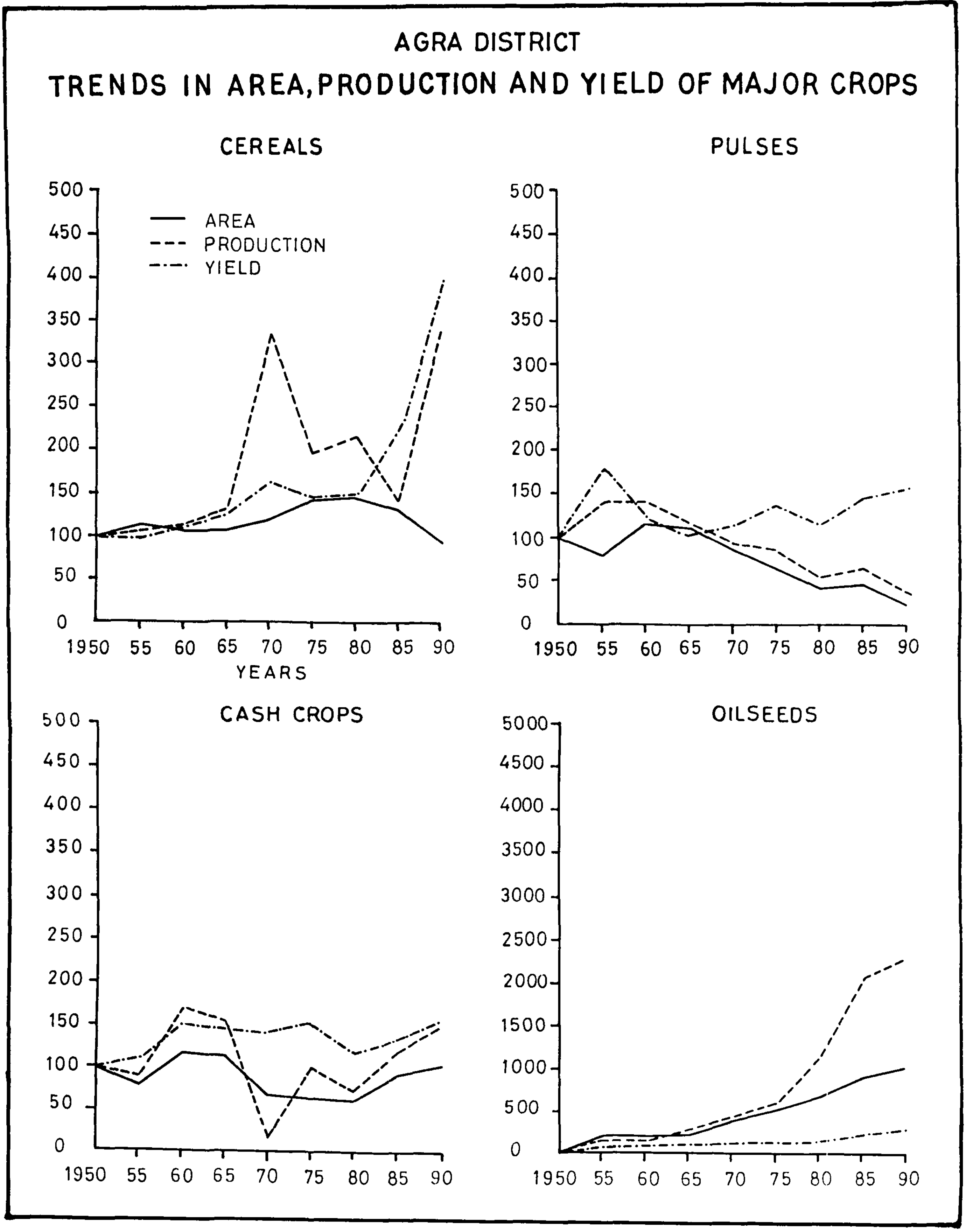
Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

hectare (70.16 per cent). The highest increase in yield under oilseeds was 3.78 quintals per hectare (125.16 per cent) in 1970-75 and the highest decrease was 0.88 quintals per hectare (21.67 per cent) in the first five years, i.e. in 1950-55. In all the forty years it increased by 4.81 quintals per hectare (118.47 per cent). The variations in area, production and yield is shown in Table XVII and its trend is shown in Fig. 24.

6.7 Agra

In Agra district, the areal extent of all the crops in the first five years, i.e. 1950-55 shows a declining trend except for oilseeds which increased by 3,163 hectares (34.34 per cent). Area under cereals declined by 202,773 hectares (96.26 per cent), that of pulses by 26,835 hectares (21.88 per cent) and of cash crops by 2,134 hectares (23.32 per cent). In the next quinquennial period in 1955-60, the areal extent of cereals and oilseeds declined by 11,408 hectares (4.80 per cent) and 2,872 hectares (23.21 per cent) respectively while the area under pulses and cash crops increased by 41,808 hectares (43.65 per cent) and 3,316 hectares (47.27 per cent) respectively. In the period between 1960-65, the overall extent of cereals decreased by 5,567 hectares (2.56 per cent), pulses decreased by 3,523 hectares (2.56 per cent) and cash crops decreased by 579 hectares (5.60 per cent) while the area under oilseeds increased by 7,627 hectares (80.27 per cent). In the next five years 1765-70, the area under cereals and oilseeds have increased while the area under pulses and cash crops decreased. The area under cereals and oilseeds increased by 24,126 hectares (10.93 per cent) and 14,249 hectares (83.19 per cent) respectively while the area under pulses and cash crops decreased by 31,015 hectares (23.13 per cent) and 3,771 hectares (28.67 per cent) respectively. In the next quinquennial period i.e. 1970-75 the area under cereals and oilseeds increased by 41,136 hectares (16.80 per cent) and 11,967 hectares (38.13 per cent) respectively. The area under pulses and cash crops decreased by 21,539 hectares (20.90 per cent) and 192 hectares (3.21 per cent) respectively. During 1975-80 the area under cereals, cash crops and oilseeds respectively increased by 13,781 hectares (4.81 per cent) by 40 hectares (0.69 per cent) and 17,845 hectares (41.17 per cent) while the area under pulses decreased by 28,534 hectares (35.01 per cent). In the next five years, in 1980-85, the area under all four crops increased except that of cereals. The area under cereals decreased by 29,459 hectares (9.82 per cent) while the area under pulses, cash crops and oilseeds increased by 3,338 hectares (6.30 per cent) by 2,295 hectares (39.37 per cent) and by 17,112 hectares (27.96 per cent) respectively. In 1985-90, the area under cereals and pulses decreased by 86,398 hectares (31.96 per cent) and 31,160 hectares (55.34 per cent) respectively while the area under cash crops and oilseeds increased by 987 hectares (12.15 per cent) and 6,094 hectares (7.78 per cent) respectively.

The production of cereals during 1950-55 increased by 17,362 metric tonnes (10.70 per cent), of pulses by 39,068 metric tonnes (38.63 per cent) and of oilseeds by 361 metric tonnes (9.97 per cent) while the production of cash crops decreased by 29,422 metric tonnes (17.31 per cent). The next *quinquennial period of 1955-60, recorded a decrease in the* production of cereals by 1,714 metric tonnes (0.95 per cent) while the production of pulses, cash crops and oilseeds increased by 71 metric tonnes (0.05 per cent) 146,840 metric tonnes (104.54 per cent) and 1,047 metric tonnes (26.31 per cent) respectively. In the next five years in 1960-65, the production of pulses and cash crops decreased by 23,285 metric tonnes (16.60 per cent) and 26,395 metric tonnes (9.88 per cent) respectively and the production of cereals and oilseeds increased by 30,680 metric tonnes (17.25 per cent) and 3,829 metric tonnes (76.18 per cent) respectively. In 1965-70 the production of cereals increased by 336,667 metric tonnes (161.46 per cent), the production of pulses and cash crops decreased by 19,365 metric tonnes (16.55 per cent) and 123,095 metric tonnes (47.54 per cent) respectively and the production of oilseeds increased by 3,845 metric tonnes (43.42 per cent). In the last quinquennial period i.e. in 1985-90, the production of cereals, cash crops and oilseeds increased by 80,972 metric tonnes (17.46 per cent), 61,581 metric tonnes (31.35 per cent) and 9,098 metric tonnes (12.28 per cent) respectively and the production



AGRA DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
PULSES
CASH CROPS
OILSEEDS
AREA
PRODUCTION
YIELD
YEARS
0
50
100
150
200
250
300
350
400
450
500
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
1950
55
60
65
70
75
80
85
90

FIG. 25

TABLE XVIII

Variations in area, production and yield of major crops in Agra District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	-202773	-11408	-5567	24126	41136	13781	-29459	-86398	-26562
		(-96 36)	(-4 80)	(-2 46)	(10 93)	(16 80)	(4 81)	(-9 82)	(-31 96)	(-12 62)
	P	17362	-1714	3068	336667	-233142	27231	124423	80972	382479
		(10 70)	(-0 95)	(17 25)	(161 46)	(-42 76)	(8 72)	(36 67)	(17 46)	(235 85)
	Y	-0 15	0 31	1 58	2 83	-1 36	0 40	5 84	12 47	21 92
		(-1 94)	(4 10)	(20 10)	(29 97)	(-11 08)	(3 66)	(51 63)	(72 71)	(284 67)
PULSES										
	A	-26835	41808	-3523	-31015	-21539	-28534	3338	-31160	-97460
		(-21 88)	(43 65)	(-2 56)	(-23 13)	(-20 90)	(-35 01)	(6 30)	(-55 34)	(-79 49)
	P	39068	71	-23285	-19365	-6798	-39404	16148	-35962	-69527
		(38 63)	(0 05)	(-16 60)	(-16 55)	(-6 96)	(-43 38)	(31 40)	(-53 22)	(-68 75)
	Y	6 39	-4 44	-1 47	0 75	1 67	-1 44	2 29	0 57	4 32
		(77 54)	(-30 34)	(-14 42)	(8 60)	(17 63)	(-12 92)	(23 60)	(4 75)	(52 42)
CASH CROPS										
	A	-2134	3316	-579	-3771	-192	40	2295	987	-38
		(-2332)	(47 27)	(-5 60)	(-38 67)	(-3 21)	(0 69)	(39 37)	(12 15)	(0 41)
	P	-29422	146840	-28395	-123095	130528	-38027	72539	61581	88097
		(-17 31)	(104 54)	(-9 88)	(-47 54)	(19 20)	(-23 48)	(58 56)	(31 35)	(51 85)
	Y	14 55	77 87	-12 61	-11 38	25 31	-67 17	29 26	41 40	97 48
		(7 83)	(38 88)	(-4 53)	(-4 28)	(9 94)	(-24 01)	(13 76)	(17 12)	(52 49)
OILSEEDS										
	A	3163	-2872	7627	14249	11967	17845	17112	6094	75185
		(34 34)	(-23 21)	(80 27)	(83 19)	(38 13)	(41 17)	(27 96)	(7 78)	(816 34)
	P	361	1047	3829	3845	11414	20371	29568	9098	79533
		(9 97)	(26 31)	(76 18)	(43 42)	(89 87)	(84 47)	(66 46)	(12 28)	(2198 25)
	Y	-0 71	2 07	-0 12	-1 09	1 49	1 71	2 18	0 40	5 93
		(-18 11)	(64 48)	(-2 27)	(-21 12)	(36 60)	(30 75)	(29 98)	(4 23)	(151 27)

A = Area

P = Production

Y = Yield

Note. Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years of pulses decreased by 35,962 metric tonnes (53.22 per cent).

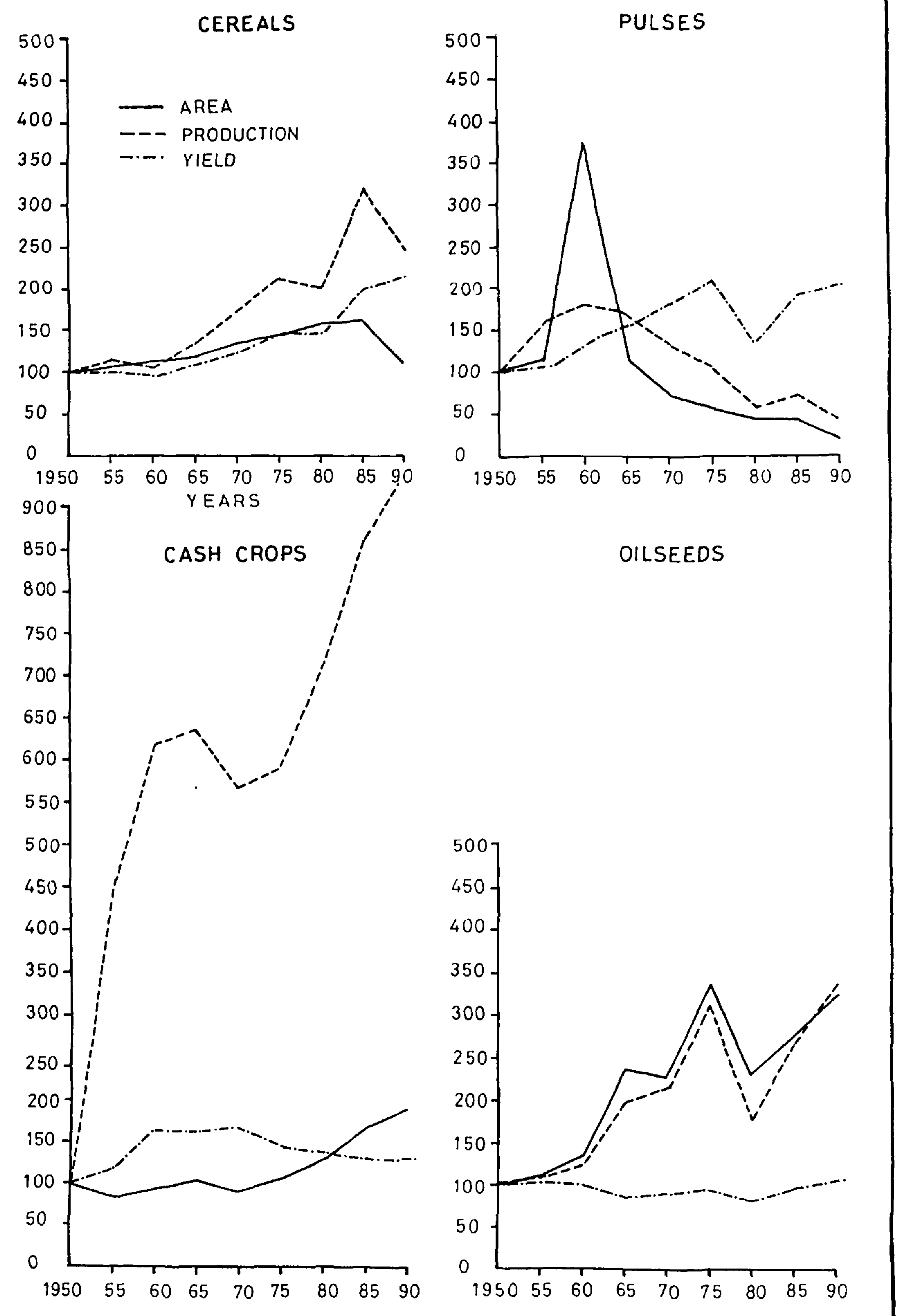
As far as the yield of different crops is concerned, highest increse in yield of cereals was recorded in 1985-90 when it was 12.47 quintals per hectare (72.71 per cent). The least increase was observed in 1955-60 when it was 0.31 quintals per hectare (4.10 per cent). The maximum decrease in yield under cereals was 1.36 quintals per hectare (11.08 per cent) in 1970-75. The highest increase in yield under pulses was recorded in 1950-55 when it was 6.39 quintals per hectare (77.54 per cent) and the highest decrease was observed in 1955-60, when it was 4.44 quintals per hectare (30.34 per cent). The highest increase in cash crops was 77.87 quintals per hectare (38.88 per cent) in 1955-60 and in oilseeds was 2.18 quintals per hectare (29.98 per cent) in 1980-85. The variations in area, production and yield is given in Table XVIII and Fig. 25.

6.8 Mainpuri

In Mainpuri district, cereals, cash crops and oilseeds show an increasing trend while pulses recorded a decreasing trend in forty years from 1950 to 1990. The area under cereals increased by 5,995 hectares (2.84 per cent) and the production increased by 273,294 metric tonnes (148.75 per cent) in 1950-90. The areal extent of pulses decreased by 57,645 hectares (79.12 per cent) in the forty years. The production of pulses also decreased by 26,075 metric tonnes (58.31 per cent) during the same period. There is an overall increase in cash

MAINPURI DISTRICT

TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS



FIG·26

TABLE XIX

Variations in area, production and yield of major crops in Mainpuri District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	16250	10917	6879	40475	17478	18949	16782	-121735	5995
		(7 70)	(4 80)	(2 88)	(16 51)	(6 12)	(8 97)	(5 21)	(-35 93)	(2 84)
	P	14630	-9931	48060	75316	75232	-22434	223127	-130706	273294
		(7 96)	(-5 00)	(25 50)	(31 84)	(24 12)	(-5 79)	(61 19)	(-22 23)	(148 75)
	Y	0 02	-0 81	1 73	1 27	1 86	-1 45	6 02	3 71	12 35
		(0 22)	(-9 28)	(21 87)	(13 17)	(17 04)	(-11 35)	(53 18)	(21 39)	(141 95)
PULSES										
	A	1305	199024	-190843	-30269	-15343	-8795	-406	-12318	-57645
		(1 79)	(268 36)	(-69 85)	(-36 75)	(-29 46)	(-23 94)	(-1 45)	(-44 26)	(-79 12)
	P	24180	11392	-3645	-17016	-13749	-22970	9845	-14112	-26075
		(54 07)	(16 53)	(-4 54)	(-22 20)	(-23 05)	(-50 06)	(42 98)	(-43 08)	(-58 31)
	Y	3 15	-1 04	1 06	2 15	1 17	-4 43	3 57	0 49	6 12
		(51 38)	(-11 20)	(12 86)	(23 11)	(10 21)	(-35 10)	(43 58)	(4 16)	(99 83)
CASH CROPS										
	A	-1734	1066	817	-1765	1781	2791	4838	1662	9456
		(-15 66)	(11 42)	(7 85)	(-15 73)	(18 84)	(24 84)	(34 49)	(8 81)	(85 43)
	P	131005	62019	8215	-26954	10388	44018	67441	23398	319530
		(348 01)	(36 77)	(3 56)	(-11 28)	(27 59)	(19 79)	(25 32)	(7 01)	(848 82)
	Y	46 67	41 11	-8 83	12 00	-26 30	-8 00	-12 96	-2 93	40 01
		(34 82)	(22 75)	(-3 98)	(5 63)	(-11 73)	(-4 04)	(-6 82)	(-1 65)	(29 85)
OILSEEDS										
	A	622	1341	8077	-618	8083	-7920	3210	3720	16515
		(8 37)	(16 66)	(86 01)	(-3 53)	(47 97)	(-31 76)	((18 86)	(18 39)	(222 36)
	P	644	935	4375	205	5761	-7156	4987	3389	13140
		(11 33)	(14 77)	(60 24)	(1 76)	(48 64)	(-40 65)	(47 73)	(21 95)	(231 21)
	Y	0 21	-0 13	-1 07	0 36	0 04	-0 92	1 49	0 23	0 21
		(2 74)	(-1 65)	(-13 84)	(5 40)	(0 56)	(-13 03)	(24 26)	(3 01)	(2 74)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

crops and oilseeds in area which increased by 9,456 hectares (85.43 per cent) and 16,515 hectares (222.36 per cent), respectively from 1950 to 1990. The production of these two crops also increased by 319,530 metric tonnes (848.82 per cent) and 13,140 metric tonnes (231.21 per cent) respectively in the same period. As far as yield of all the four crops namely cereals, pulses, cash crops and oilseeds is concerned, it recorded an overall increase in 1950-90. It decreased by 12.35 quintals per hectare (141.95 per cent), 6.12 quintals per hectare (99.83 per cent), 40.01 quintals per hectare (29.85 per cent) and 0.21 quintals per hectare (2.74 per cent) respectively in the same period. The variations in area, production, and yield is given in Table XIX and its trends in Fig. 26.

6.9 Etah

Etah district witnessed only a few losses in area and production of cereals but on an average both have progressed in the total span of time under consideration. The highest decrease of 65,102 hectares (25.16 per cent) in area under cereals was recorded in 1950-55. The highest increase in area for the same 70,961 hectares (36.64 per cent) observed in 1955-60. As against it, the highest increase in production was seen in 1980-85 with 165,827 metric tonnes (40.73 per cent). The lowest increase in production under cereals was 3,345 metric tonnes (1.56 per cent) in 1955-60. The highest decrease in the cereals was 15,057 metric tonnes (4.20 per cent) in 1970-75. As far as yield of cereals is concerned, the highest increase of 4.86 quintals per hectare (40.46 per cent) was recorded in 1980-85. The maximum decrease in yield under the same crop was 2.83 quintals per hectare (25.68 per cent) in 1955-60. The period 1965-70 recorded the lowest increase in yield under cereals being 1.33 quintals per hectare (13.61 per cent).

The area under pulses shows an increasing trend in the first fifteen years, but in the last twenty years the area underwent a decrease. The highest increase in area under pulses was recorded in the last quinquennial period, i.e. in 1985-90, when it was 13,763 hectares (31.42 per cent). As against this, the highest increase in production was recorded in the same period, i.e. 1985-90, when it was 29,565 metric tonnes (55.11 per cent). The highest decrease in area was 31,796 hectares (34.07 per cent) in 1965-70. The highest decrease in production was observed in 1975-80, when it was 21,180 metric tonnes (32.82 per cent).

The area under cash crops in general shows a decreasing trend. The maximum increase was 3,872 hectares, (25.62 per cent) in 1955-60. As against this, the highest increase in production was 168,085 metric tonnes (50.98 per cent) in 1960-65. The highest decrease in area under the same crop was observed as 3,023 hectares (18.22 per cent) in 1965-70. As against this the highest increase in production was recorded as 124,366 metric tonnes (24.98 per cent) in the same period,

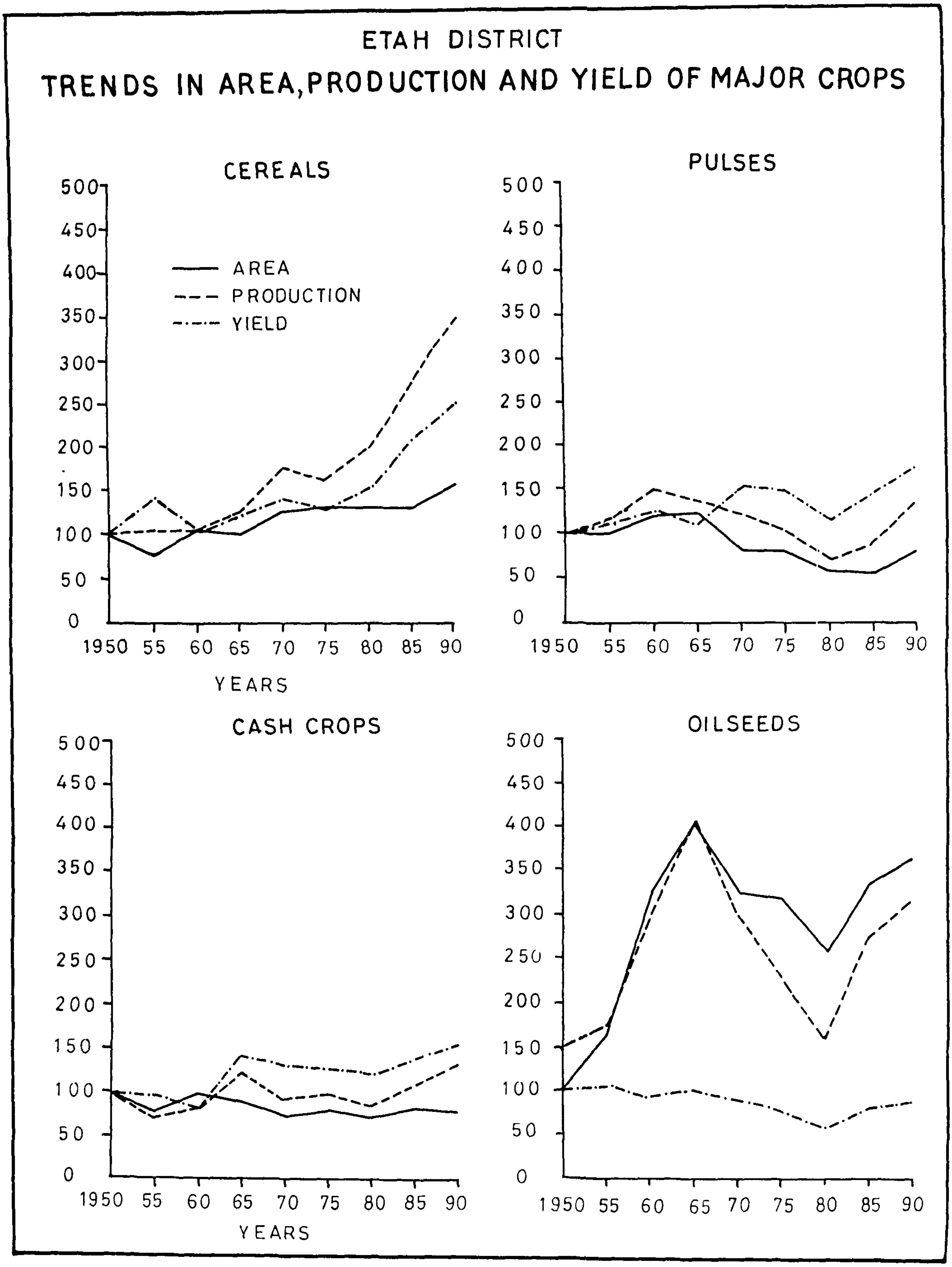

ETAH DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
PULSES
CASH CROPS
OILSEEDS
500
450
400
350
300
250
200
150
100
50
0
1950
55
60
65
70
75
80
85
90
YEARS

FIG. 27

TABLE XX

Variations in area, production and yield of major crops in Etah District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	-65102	70961	-2568	60193	10553	5935	777	18358	99107
		(-25 16)	(36 64)	(-0 97)	(22 97)	(3 27)	(1 78)	(0 22)	(5 40)	(38 30)
	P	7961	3345	39349	101710	-15057	64262	165827	145697	513094
		(3 87)	(1 56)	(18 15)	(39 70)	(-4 20)	(18 74)	(40 73)	(25 43)	(249 70)
	Y	3 08	-2 83	1 58	1 33	-0 80	1 71	4 86	3 16	12 14
		(38 79)	(-25 68)	(19 29)	(13 61)	(-7 20)	(16 60)	(40 46)	(18 73)	(152 89)
PULSES										
	A	860	13727	2539	-31796	-9741	-5506	-2456	13763	-18610
		(1 12)	(17 81)	(2 79)	(-34 07)	(-15 83)	(-10 63)	(-5 30)	(31 42)	(-24 43)
	P	9370	22359	-7634	-9666	-13039	-21180	10304	29565	20079
		(14 84)	(30 83)	(-8 04)	(-11 08)	(-16 81)	(-32 82)	(23 77)	(55 11)	(31 80)
	Y	1 13	1 04	-1 11	3 27	-0 15	-3 10	2 88	2 21	6 17
		(13 64)	(11 05)	(-10 62)	(35 01)	(-1 18)	(-24 87)	(30 76)	(18 05)	(74 51)
CASH CROPS										
	A	-3822	3872	-2392	-3023	948	-630	1315	1057	-2675
		(-20 18)	(25 62)	(-12 60)	(-18 22)	(6 98)	(-4 34)	(9 46)	(6 95)	(-14 12)
	P	106696	29928	168085	-1224366	15106	-36438	85981	87495	119092
		(26 25)	(9 98)	(50 98)	(-24 98)	(4 04)	(-9 37)	(24 42)	(19 97)	(29 30)
	Y	-16 32	-24 69	126 35	-24 82	-7 57	-14 09	34 63	35 08	108 57
		(-7 60)	(-12 44)	(72 76)	(-8 27)	(-2 75)	(-5 26)	(13 65)	(12 17)	(50 57)
OILSEEDS										
	A	3615	8785	4743	-4316	-337	-3235	4237	1566	15068
		(63 77)	(94 63)	(26 41)	(-18 89)	(-1 81)	(-17 78)	(28 33)	(8 16)	(265 84)
	P	3615	6278	5372	-5067	-3506	-3614	5553	2264	10895
		(73 32)	(73 46)	(36 24)	(-25 09)	(-23 17)	(-31 09)	(69 34)	(16 69)	(220 99)
	Y	0 51	-1 00	0 64	-0 68	-1 78	-1 03	1 71	0 56	-1 07
		(5 86)	(-10 86)	(7 80)	(-7 69)	(-21 81)	(16 14)	(31 96)	(7 93)	(-12 31)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

i.e. 1965-70. The area and production under oilseeds show a very interesting picture as they are more or less correlated with each other. Whenever area decreases, production follows suit and decreases. The highest increase in area under oilseeds was 8,785 hectares (94.63 per cent) in 1955-60. As against this, the highest increase in production was 6,278 metric tonnes (73.46 per cent) in the same period. The highest decrease in area under the same crop was 4,316 hectares (18.89 per cent) in 1965-70 while the highest decrease in production was 5,076 metric tonnes (25.09 per cent) in the same period.

The yield of cereals, pulses and cash crops increased by 12.14 quintals per hectare (152.89 per cent), 6.17 quintals per hectare (74.57 per cent) and 108.57 quintals per hectare (50.57 per cent) in all the forty years. The yield of oilseeds however recorded a decrease of 1.07 quintals per hectare (12.31 per cent) during the same period. The variations in area, production and yield is given in Table XX and its trends is shown in Fig. 27.

6.10 Budaun

In Budaun district, the area under cereals, pulses and oilseeds increased by 24,741 hectares (8.02 per cent), 2,509 hectares (2.78 per cent) and 6080 hectares (69.35 per cent) respectively in the first quinquennial period, i.e. in 1950-55. The area under cash crops decreased by 8,648 hectares (28.46 per cent) in the same period while the production under cereals and oilseeds increased by 732 metric tonnes (3.80 per cent) and 9,631 metric tonnes (113.77 per cent) respectively in the same period. The production of pulses and cash crops decreased by 9,050 metric tonnes (13.85 per cent) and by 226,451 metric tonnes (27.30 per cent) respectively in the same period. In the last quinquennial period i.e. 1985-90, the position changed. The area under cereals and cash crops increased while the area under pulses and oilseeds decreased. There is an increase of 2,866 hectares (0.68 per cent) in the area under cereals and an increase of 5,817 hectares (18.92 per cent) in area under cash crops in the same period. Pulses and oilseeds decreased in area by 11,020 hectares (23.73 per cent) and 887 hectares (3.39 per cent) respectively in the same period. The production of cereals and cash crops increased by 146,288 metric tonnes (22.60 per cent) and by 32,990 metric tonnes (2.84 per cent) respectively in the last quinquennial period, i.e. 1985-90. The production of pulses and oilseeds decreased by 27,316 metric tonnes (49.52 per cent) and 1,846 metric tonnes (11.70 per cent) in the same period. As far as yield of all the crops in all the forty years is concerned it recorded an increase for all the crops except oilseeds. The yield of cereals, pulses and cash crops increased by 12.15 quintals per hectare (184.09 per cent), 0.61 quintals per hectare (8.41 per cent) and 52.99 quintals per hectare (19.41 per cent) respectively in all the forty years. The yield of oilseeds decreased by 4.14 quintals per hectare (42.90 per

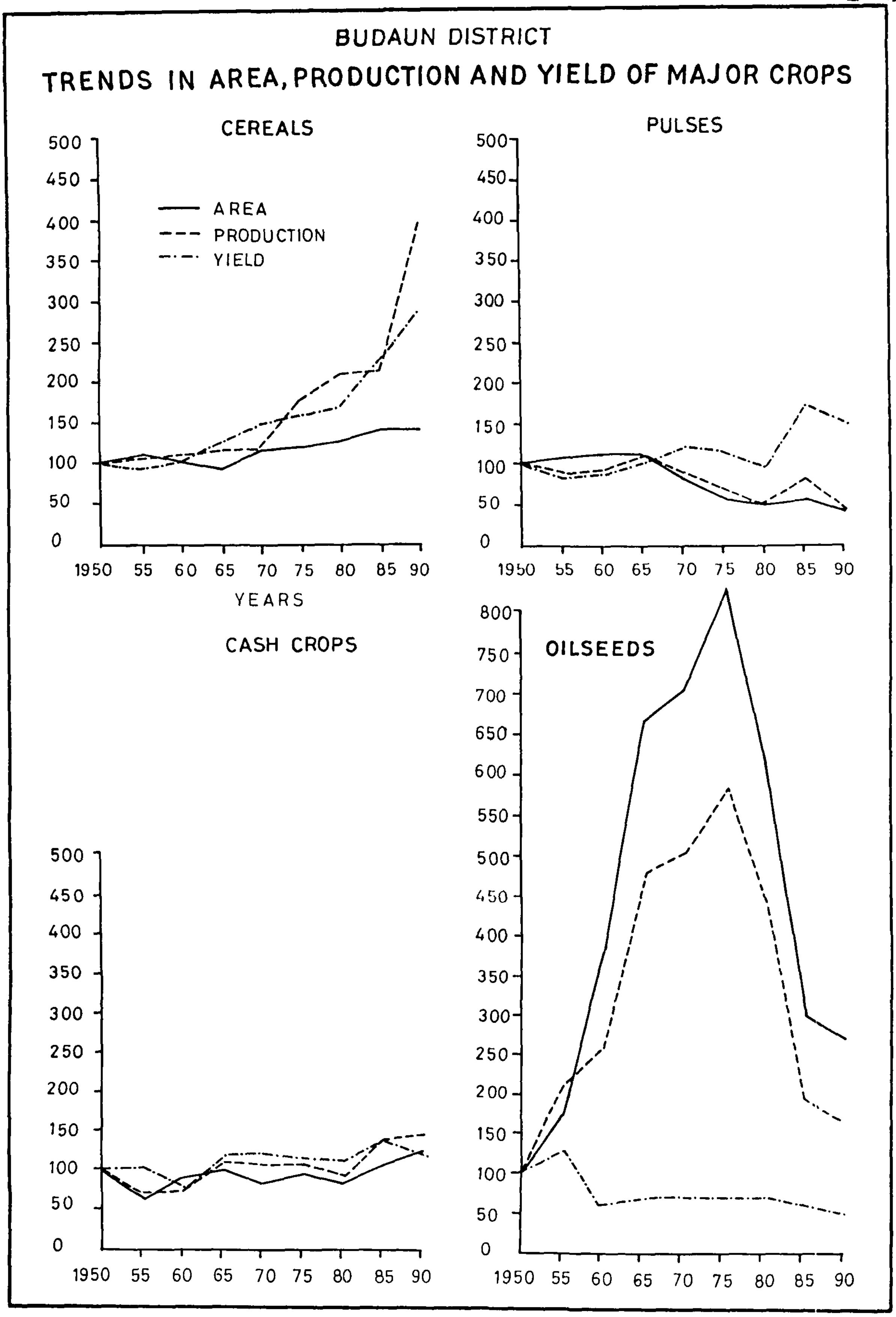

BUDAUN DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
PULSES
CASH CROPS
OILSEEDS
AREA
PRODUCTION
YIELD
YEARS
500
450
400
350
300
250
200
150
100
50
0
800
750
700
650
600
550
1950
55
60
65
70
75
80
85
90

FIG-28

TABLE XXI

Variations in area, production and yield of major crops in Budaun District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	24741	-28018	-26752	71772	1221	31533	37640	2866	11500
		(8 02)	(-8 41)	(-8 77)	(25 80)	(0 34)	(8 98)	(9 83)	(0 68)	(37 30)
	P	7732	2405	9832	121984	17027	59333	225509	146288	59011
		(3 80)	(1 13)	(4 60)	(54 59)	(4 92)	(16 37)	(53 46)	(22 60)	(290 00)
	Y	-0 26	0 66	1 03	1 84	0 45	0 70	4 37	3 36	12 15
		(-3 93)	(10 41)	(14 71)	(22 91)	(4 55)	(6 78)	(30 65)	(21 83)	(184 09)
PULSES										
	A	2509	7082	-3413	-24698	-20471	-2919	-1693	-11020	5462
		(2 78)	(7 65)	(-3 42)	(-25 67)	(-28 62)	(-5 71)	(-3 51)	(-23 73)	(60 60)
	P	-9050	3244	8713	-7908	-18641	-7911	21388	-27316	-3748
		(-13 85)	(5 76)	(14 64)	(-11 59)	(-30 90)	(-18 98)	(63 34)	(-49 52)	(57 30)
	Y	-1 17	-0 11	1 12	1 34	-0 18	-1 15	4 87	-4 02	0 61
		(-16 13)	(-1 80)	(18 76)	(18 89)	(-2 13)	(14 09)	(69 47)	(-33 83)	(8 41)
CASH CROPS										
	A	-8648	4863	3174	-3064	1097	-2329	5265	5817	6175
		(-28 46)	(22 38)	(11 93)	(-10 29)	(4 10)	(-8 37,	(20 67)	(18 92)	(20 32)
	P	-226451	-9164	395265	-140509	58491	-141197	392851	32990	36227
		(-27 30)	(-1 52)	(66 58)	(-14 20)	(6 89)	(-15 56)	(51 30)	(2 84)	(43 60)
	Y	4 43	-54 18	108 99	-14 50	8 50	-25 60	76 32	-50 97	52 99
		(1 62)	(-19 52)	(48 81)	(-4 36)	(2 67)	(-7 84)	(25 38)	(-13 52)	(19 41)
OILSEEDS										
	A	6080	18602	24840	3976	10564	-19430	-27245	887	16500
		(69 35)	(125 29)	(74 26)	(6 82)	(16 96)	(-26 67)	(-51 02)	(-3 39)	(188 20)
	P	9631	3743	18744	1950	6551	-11531	-21984	-1846	5458
		(113 77)	(20 68)	(85 82)	(4 80)	(15 87)	(-23 39)	(-58 23)	(-11 70)	(64 47)
	Y	2 53	-5 66	0 44	-0 13	-0 07	0 30	-1 04	-0 51	4 14
		(26 21)	(-46 46)	(6 74)	(-1 86)	(-1 02)	(4 43)	(14 73)	(-8 47)	(-42 90)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

cent) during the same period. The variations in area, production and yield is given in Table XXI and its trend is shown in Fig. 28.

6.11 Shahjahanpur

The district of Shahjahanpur also shows a similar pattern with regard to area and production of pulses. In all the forty years pulses area decreased by 37,804 hectares (51.13 per cent) together with total production which also decreased by 21,025 metric tonnes (41.67 per cent) during the same period. The area of cereals, cash crops and oilseeds increased by 172,837 hectares (82.69 per cent), 3,581 hectares (11.12 per cent) and 10,776 hectares (2506.04 per cent) respectively in forty years. As against this production of these crops increased by 769,038 metric tonnes (626.63 per cent), 867,505 metric tonnes (103.04 per cent) and 5,752 metric tonnes (2069.06 per cent) respectively in the same period. As far as yield of all the crops is concerned, it shows an increasing trend except in case of oilseeds which decreased by 1.08 quintals per hectare (16.71 per cent) in the forty years. The yield of cereals, pulses and cash crops increased by 17.51 quintals per hectare (298.29 per cent), 1.32 quintals per hectare (19.35 per cent) and 216.32 quintals per hectare (82.72 per cent) respectively in the same period. The periodwise variations in area, production and yield is given in Table XXII and its trends is shown in Fig. 29.

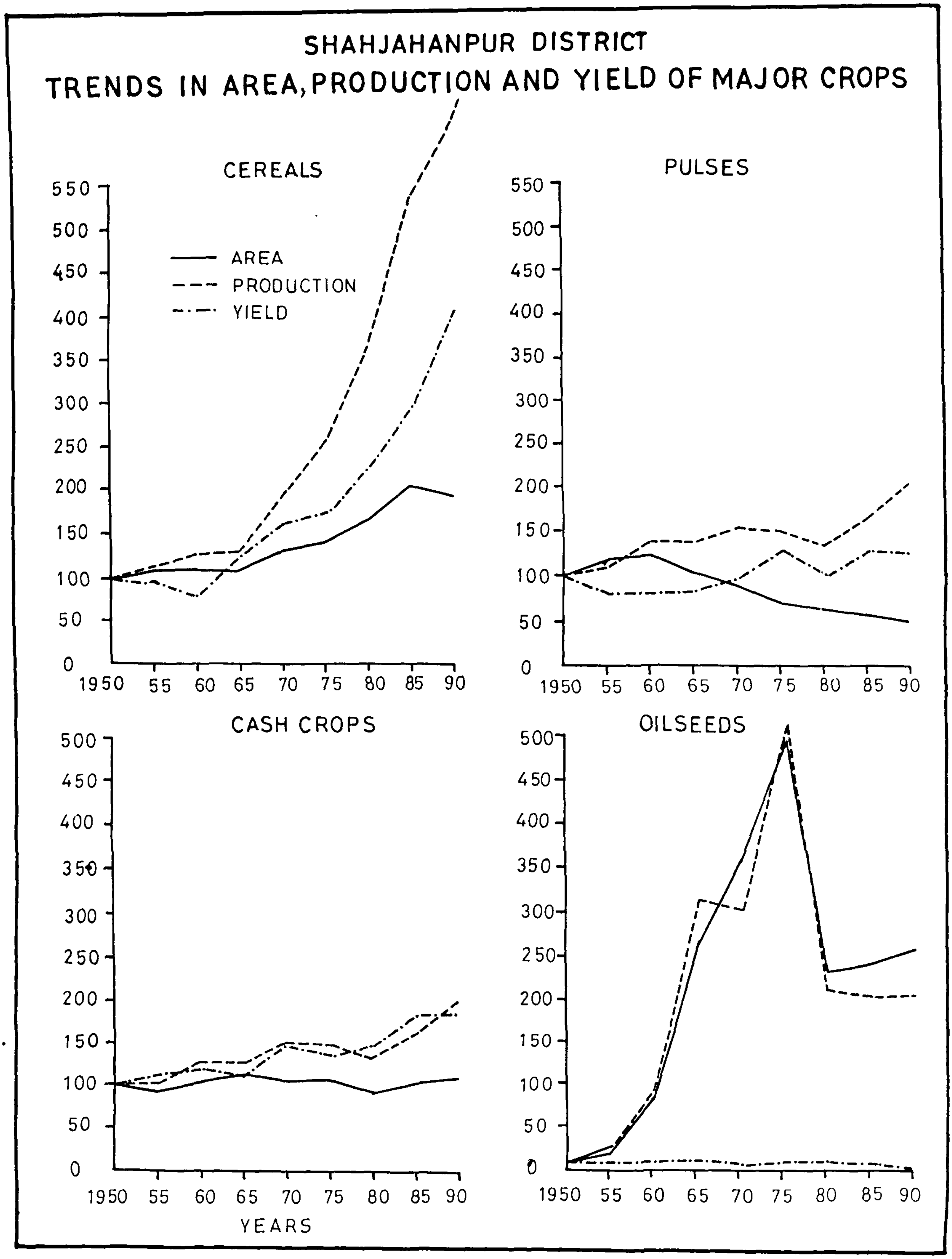

SHAHJAHANPUR DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
PULSES
CASH CROPS
OILSEEDS
0
50
100
150
200
250
300
350
400
450
500
550
1950
55
60
65
70
75
80
85
90
YEARS

FIG.29

TABLE XXII

Variations in area, production and yield of major crops in Shahjahanpur District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950 90
CEREALS										
	A	26253	-5343	-7413	41533	21614	54596	78874	-37477	17263
		(12 57)	(-2 27)	(-3 22)	(18 68)	(8 19)	(19 12)	(23 19)	(-8 94)	(82 60)
	P	8897	25062	-231	85865	68916	133595	263387	183547	76903
		(7 24)	(19 04)	(-0 14)	(54 88)	(28 44)	(42 92)	(59 21)	(25 91)	(626 60)
	Y	-0 27	1 22	0 21	2 15	1 72	2 18	3 82	6 48	17 5
		(-4 59)	(21 78)	(3 07)	(30 58)	(18 73)	(20 00)	(29 20)	(38 34)	(298 20)
PULSES										
	A	13135	3234	-14073	-10023	-18691	-2150	-7377	-1859	-378
		(17 76)	(3 71)	(-15 58)	(-13 14)	(-28 23)	(-4 52)	(-16 26)	(-4 89)	(-51 13)
	P	-3472	1467	-2855	-2269	-2683	-10199	3985	-4995	-21025
		(-6 88)	(3 12)	(-5 89)	(-4 97)	(-6 19)	(-25 10)	(13 09)	(-14 51)	(-41 63)
	Y	-1 43	-0 03	0 61	0 57	2 01	-1 85	2 36	-0 92	1 32
		(-20 96)	(-0 55)	(11 38)	(9 54)	(30 73)	(-21 63)	(35 22)	(-10 15)	(19 35)
CASH CROPS										
	A	-1799	3892	2326	-2963	2037	-6686	3643	3131	3581
		(-5 58)	(12 80)	(6 78)	(-8 09)	(6 05)	(-18 23)	(12 55)	(9 58)	(11 12)
	P	44992	222907	-20120	192325	-14422	-171048	311929	301142	867705
		(5 34)	(25 12)	(-1 81)	(17 64)	(-1 12)	(-13 49)	(28 44)	(21 37)	(103 04)
	Y	30 27	31 89	-26 05	83 34	-25 78	22 89	53 37	46 41	216 32
		(11 57)	(10 93)	(-8 04)	(28 00)	(-6 76)	(6 44)	(14 11)	(10 75)	(82 77)
OILSEEDS										
	A	496	2650	7740	4147	5827	11017	275	658	10776
		(115 34)	(286 17)	(216 44)	(36 64)	(37 68)	(51 74)	(2 67)	(6 23)	(2506 04)
	P	360	2033	6493	-768	6033	-8053	-656	310	5752
		(229 49)	(741 94)	(243 09)	(-8 38)	(71 85)	(-55 81)	(-10 28)	(5 41)	(2069 06)
	Y	0 42	0 58	0 63	-2 67	1 35	-0 57	-0 78	-0 04	-1 08
		(6 50)	(8 43)	(8 44)	(-33 00)	(24 90)	(-8 41)	(-12 58)	(-0 73)	(-16 71)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

6.12 Moradabad

Moradabad district, recorded an increase of 18,621 hectares (5.76 per cent) in area under cereals in 1950-55. As against this, the production of this crop increased by 24,619 metric tonnes (12.72 per cent) in the same period. In the last quinquennial period, i.e. 1985-90, the area under cereals decreased by 38,623 hectares (8.22 per cent), while the production increased by 79,315 metric tonnes (9.42 per cent). The area and production of pulses in the first and last quinquennial period recorded a decrease. The area under pulses in 1950-55 decreased by 272 hectares (0.41 per cent) and the production decreased by 6,972 metric tonnes (15.84 per cent). In the last quinquennial period in 1985-90, the area of this crop further decreased by 1,973 hectares (13.64 per cent) and the production decreased by 4,604 metric tonnes (33.74 per cent). The area under cash crops in the first quinquennial period decreased by 3,964 hectares (6.89 per cent) but it increased in the last quinquennial period, i.e. in 1985-90 by 21,594 hectares (16.34 per cent). The production of this crop decreased by 142,069 metric tonnes (8.24 per cent) in 1950-55 but increased by 1,068,086 metric tonnes (16.94 per cent) in 1985-90. The area and production of oilseeds shows an increasing trend. In the first five years, i.e. 1950-55, the area under oilseeds increased by 2,043 hectares (25.67 per cent) and further increased by 7,517 hectares (56.42 per cent) in 1985-90. The

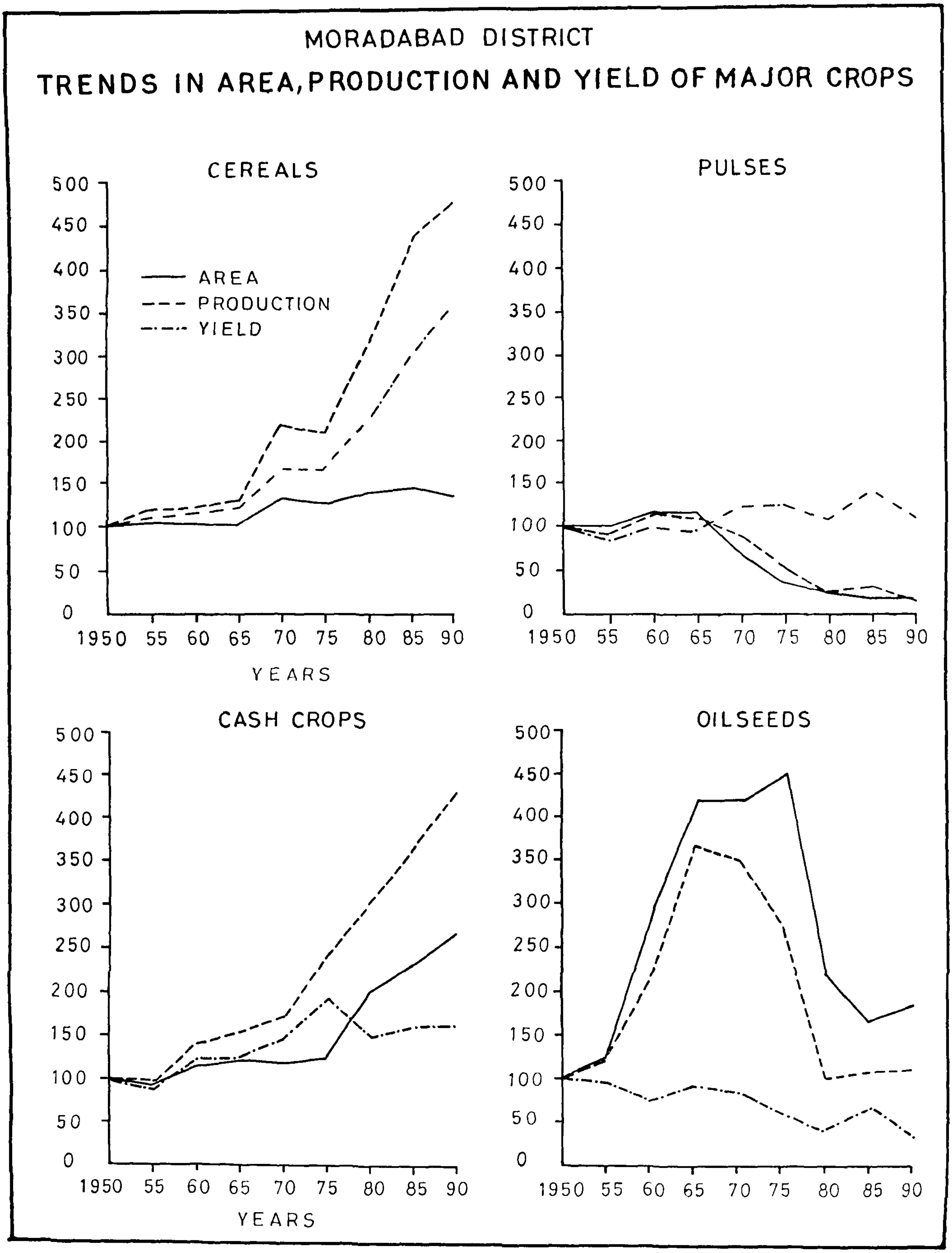

MORADABAD DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
PULSES
CASH CROPS
OILSEEDS
AREA
PRODUCTION
YIELD
500
450
400
350
300
250
200
150
100
50
0
1950
55
60
65
70
75
80
85
90
YEARS

FIG. 30

TABLE XXIII

Variations in area, production and yield of major crops in Moradabad District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	18621	-218	-3694	91155	-14342	31936	23026	-38623	107861
		(5 76)	(-0 0006)	(-0 010)	(-0 269)	(-0 033)	(7 69)	(5 15)	(-8 22)	(33 36)
	P	24619	15686	11059	180886	-19452	198490	236420	79315	727023
		(12 72)	(7 19)	(4 72)	(73 85)	(-4 56)	(48 84)	(39 08)	(9 42)	(375 63)
	Y	0 40	0 46	0 40	2 68	-0 13	3 74	4 37	3 45	15 37
		(6 68)	(7 21)	(5 84)	(37 01)	(-1 31)	(38 20)	(32 29)	(19 27)	(257 02)
PULSES										
	A	-272	10736	247	-30124	-19541	-10346	-2415	-1973	-53688
		(-0 41)	(16 29)	(0 32)	(-39 18)	(-41 79)	(-38 01)	(-14 31)	(-13 64)	(81 13)
	P	-6972	13128	-1313	-10452	-15787	-10266	1302	-4604	-34964
		(-15 84)	(35 45)	(-2 61)	(-21 39)	(-41 11)	(-45 41)	(10 55)	(-33 74)	(-79 45)
	Y	-1 03	0 93	-0 19	1 86	0 09	-0 99	2 12	-2 19	0 60
		(15 51)	(16 57)	(-2 90)	(29 29)	(1 09)	(-11 92)	(29 00)	(-23 22)	(9 03)
CASH CROPS										
	A	-3964	11553	4687	-2504	3938	44264	16662	21594	96230
		(6 89)	(21 59)	(40 59)	(-53 42)	(6 85)	(62 18)	(14 43)	(16 34)	(167 44)
	P	-142069	789681	234234	335860	1149161	1127091	1088643	1068086	5650687
		(-8 24)	(49 97)	(9 88)	(12 89)	(39 09)	(27 56)	(20 87)	(16 94)	(328 13)
	Y	-4 36	68 25	9 10	63 85	137 26	137 00	25 42	2 44	180 03
		(-1 45)	(23 11)	(2 49)	(17 10)	(31 40)	(23 84)	(5 62)	(0 51)	(60 08)
OILSEEDS										
	A	2043	12710	10823	34	2259	-18306	-4198	7517	12882
		(25 67)	(127 10)	(47 65)	(0 10)	(6 72)	(-51 09)	(-23 96)	(56 42)	(161 89)
	P	1554	5986	11207	-1042	-4952	-12301	490	344	885
		(21 96)	(69 37)	(76 68)	(-4 03)	(-19 98)	(-63 31)	(6 87)	(4 51)	(11 11)
	Y	-0 27	2 19	1 27	-0 32	-1 96	-1 36	1 65	-1 90	-5 08
		(-3 03)	(25 40)	(19 75)	(-4 15)	(-26 55)	(-25 09)	(40 64)	(-33 27)	(-57 14)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

production of the same crop increased by 1,554 metric tonnes (21.96 per cent) in the first five years in 1950-55 but in the last five years, i.e. in 1985-90, the increase was of 344 metric tonnes (4.51 per cent). As far as the yield of different crops is concerned, cereals, pulses and cash crops recorded an increasing trend while the oilseeds, observed a downward trend. The overall picture in forty years of 1950-90 reveals that cereals increased by 15.37 quintals per hectare (257.02 per cent), pulses increased by 0.60 quintals per hectare (9.30 per cent) and cash crops increased by 180.03 quintals per hectare (60.08 per cent), but the yield of oilseeds decreased by 5.08 quintals per hectare (57.14 per cent). The variations in area, production and yield is given in Table XXIII and its trends is shown in Fig. 30.

6.13 Farrukhabad

The area under cereals in Farrukhabad district during 1950-55 increased upto 14,624 hectares (7.27 per cent) but in the last quinquennial period, i.e. in 1985-90 it decreased by 25,864 hectares (9.02 per cent). As against this the production of cereals in the first five years increased by 18,918 metric tonnes (12.01 per cent) and further increased by 68,333 metric tonnes (13.32 per cent) in the last five years, i.e. in 1985-90. The area and production of pulses in 1950-55 increased by 2,232 hectares (3.27 per cent) and 8,780 metric tonnes (16.38 per cent) respectively while in the last

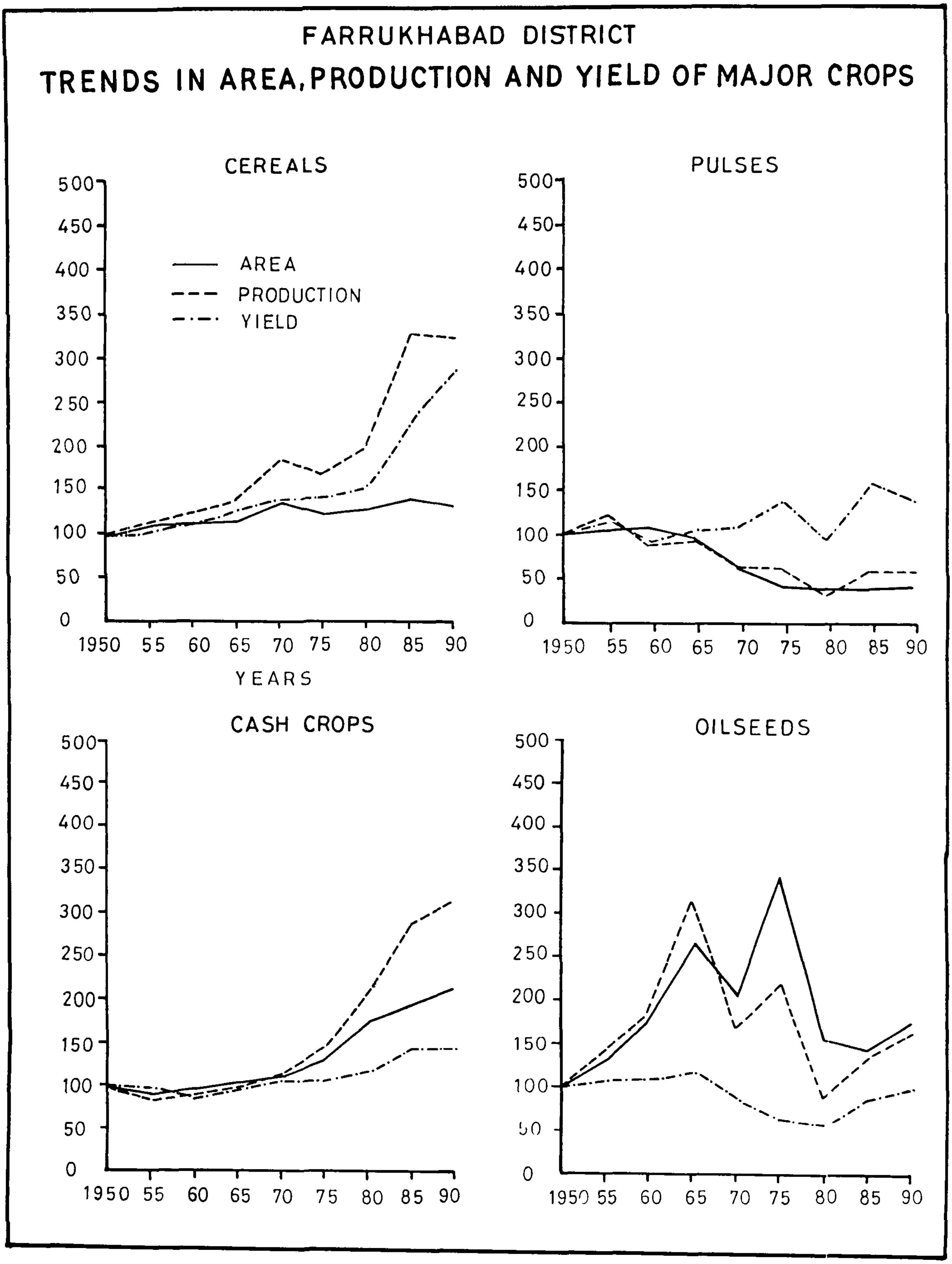

FARRUKHABAD DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
PULSES
CASH CROPS
OILSEEDS
AREA
PRODUCTION
YIELD
YEARS
0
50
100
150
200
250
300
350
400
450
500
1950
55
60
65
70
75
80
85
90

FIG.31

TABLE XXIV

Variations in area, production and yield of major crops in Farrukhabad District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	14624	7769	3030	45882	-25854	10388	29848	-25864	59826
		(7 27)	(3 60)	(1 35)	(20 26)	(-9 49)	(4 21)	(11 61)	(-9 02)	(29 75)
	P	18918	20390	28436	72621	-27479	35624	210636	68333	427479
		(12 01)	(11 55)	(14 45)	(32 24)	(-9 27)	(13 17)	(68 83)	(13 22)	(271 46)
	Y	0 34	0 63	1 14	0 99	0 03	0 95	6 10	4 41	14 59
		(4 34)	(7 71)	(12 95)	(9 95)	(0 27)	(8 66)	(51 21)	(24 48)	(186 33)
PULSES										
	A	2232	-306	-5000	-20107	-15205	-2296	261	871	-39550
		(3 27)	(-0 43)	(-7 13)	(-30 87)	(-33 78)	(-7 70)	(0 94)	(3 13)	(-57 99)
	P	8780	-13961	2943	-13612	-4004	-13087	14078	-1797	-20660
		(16 38)	(-22 38)	(6 07)	(-26 50)	(-10 60)	(-38 77)	(68 14)	(-5 17)	(-38 54)
	Y	0 99	-1 95	0 98	0 50	2 94	-3 82	5 00	-1 00	3 64
		(12 59)	(-22 03)	(14 20)	(6 34)	(35 08)	(33 74)	(66 66)	(-8 00)	(46 31)
CASH CROPS										
	A	-3221	2643	1895	733	6696	10928	4284	5873	29831
		(-12 42)	(11 64)	(7 47)	(2 69)	(23 94)	(31 52)	(9 39)	(11 77)	(115 09)
	P	-65393	2963	69669	46670	129998	295983	371123	97505	29831
		(-14 02)	(0 74)	(17 25)	(9 85)	(24 99)	(45 53)	(39 22)	(7 40)	(106 94)
	Y	-3 29	-17 25	14 09	12 54	1 58	19 97	56 59	-10 33	73 90
		(-1 82)	(-9 77)	(8 84)	(7 23)	(0 84)	(10 64)	(27 27)	(-3 91)	(41 08)
OILSEEDS										
	A	3418	4670	8984	-6117	14904	-20227	-579	3006	8059
		(31 74)	(32 92)	(47 65)	(-21 97)	(68 61)	(-55 27)	(-3 53)	(19 00)	(74 85)
	P	3568	4625	12109	-13505	4981	-12762	3810	2599	5425
		(36 61)	(34 74)	(67 50)	(-44 94)	(30 11)	(-59 29)	(43 48)	(20 67)	(55 66)
	Y	0 33	0 13	1 28	-3 18	-1 78	-0 53	2 60	0 11	-1 00
		(3 64)	(1 38)	(13 45)	(-29 47)	(-22 86)	(-9 02)	(48 68)	(1 38)	(-11 04)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

quinquennial period of 1985-90, the area under pulses recorded an increase of 871 hectares (3.13 per cent) while the production decreased by 1,797 metric tonnes (5.17 per cent). The area and production of cash crops in the period 1950-55, decreased by 3,221 hectares (12.42 per cent) and 6,539 metric tonnes (14.02 per cent) respectively but later on increased in the last five years in 1985-90 by 5,873 hectares (11.77 per cent) and 97,505 metric tonnes (7.40 per cent) respectively. The oilseeds area increased by 3,418 hectares (31.34 per cent) in 1950-55 and increased by 3,006 hectares (19.00 per cent) in 1985-90 as against this the production of oilseeds recorded an increase of 3,568 metric tonnes (36.61 per cent) in the first quinquennial period and 2,599 metric tonnes (20.67 per cent) in the last quinquennial period. As far as yield of cereals, pulses and cash crops is concerned it has increased in forty years. The yield of cereals increased by 14.59 quintals per hectare (186.33 per cent), pulses by 3.64 quintals per hectare (46.31 per cent) and cash crops increased by 73.09 quintals per hectare (41.08 per cent). The yield of oilseeds decreased by 1.00 quintals per hectare (11.04 per cent) in forty years from 1950 to 1990. The variations in area, production and yield is given in Table XXIV and its trends is shown in Fig. 31.

6.14 Etawah

Etawah district, experienced an increasing trend in area under cereals, cash crops and oilseeds, while pulses

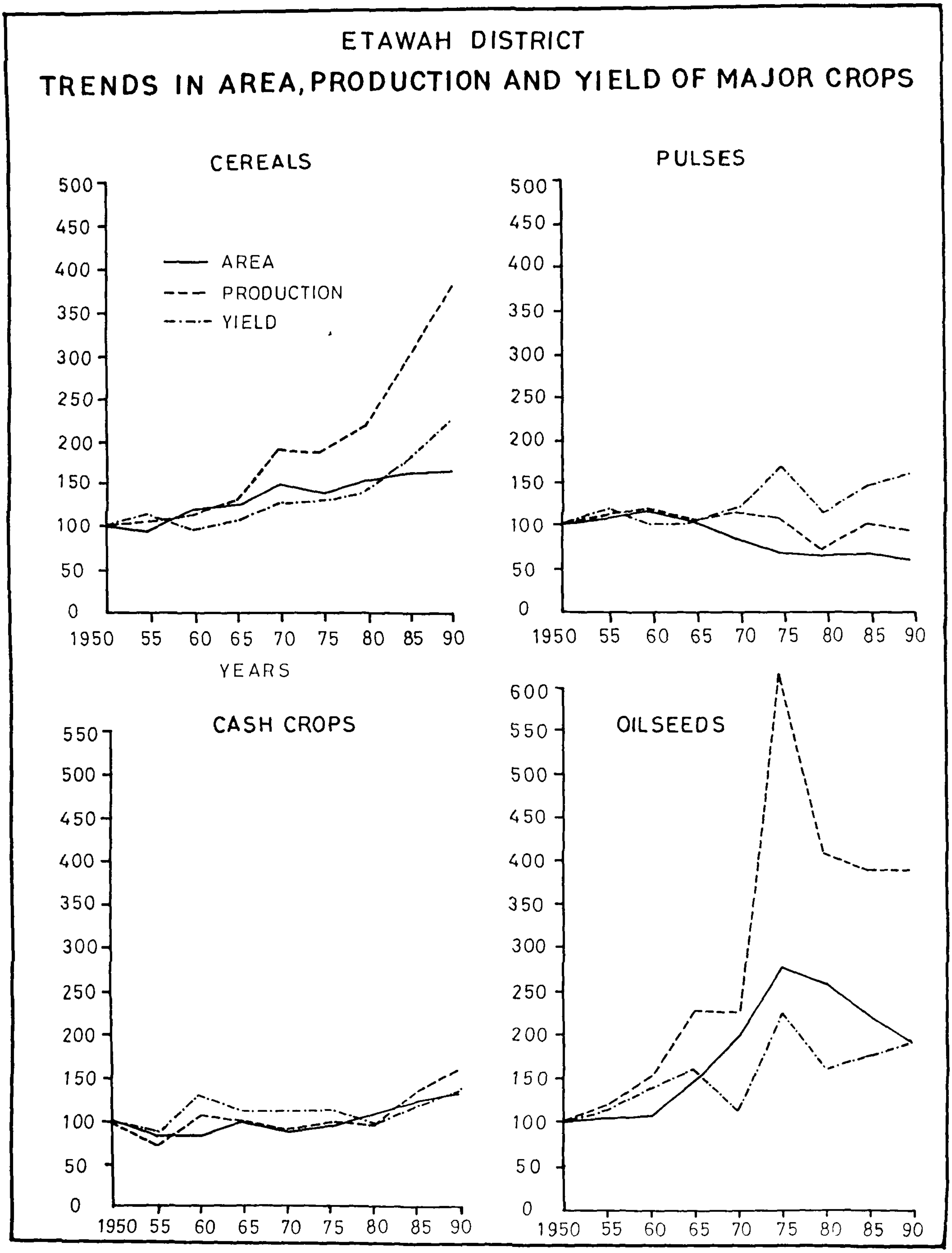

ETAWAH DISTRICT
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
YEARS
PULSES
CASH CROPS
OILSEEDS
0
50
100
150
200
250
300
350
400
450
500
550
600
1950
55
60
65
70
75
80
85
90

FIG. 32

TABLE XXV

Variations in area, production and yield of major crops in Etawah District

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	-10668	48376	7905	43056	-13134	25166	19078	1154	120933
		(-5 88)	(28 33)	(3 60)	(18 96)	(-4 86)	(9 79)	(6 76)	(0 38)	(66 66)
	P	9247	16758	23866	101837	-2140	47478	140884	125345	463275
		(5 45)	(9 37)	(12 20)	(46 41)	(-0 66)	(14 87)	(38 43)	(24 70)	(273 27)
	Y	1 13	-1 55	0 74	2 23	0 52	0 58	3 85	4 09	11 59
		(12 09)	(-14 80)	(8 29)	(23 [illegible])	(4 37)	(4 67)	(27 55)	(24 28)	(124 08)
PULSES										
	A	3201	10412	-9518	-20936	-12912	-3243	3298	-5128	-34827
		(3 73)	(11 70)	(-9 58)	(-23 30)	(-18 74)	(-5 79)	(6 25)	(-27 00)	(-40 62)
	P	8009	5181	-10002	6677	-4450	-28922	20582	3757	-6682
		(10 55)	(6 17)	(-11 22)	(8 44)	(-5 18)	(-35 56)	(39 28)	(-5 14)	(-8 80)
	Y	0 58	-0 47	-0 16	3 65	2 07	-4 59	3 09	0 57	4 74
		(6 55)	(-4 98)	(-1 78)	(41 47)	(16 62)	(-31 61)	(31 11)	(4 37)	(53 55)
CASH CROPS										
	A	-2166	-241	1428	-1084	558	1641	2099	783	3018
		(-17 50)	(-2 36)	(14 33)	(-9 51)	(5 41)	(15 10)	(16 78)	(5 36)	(24 39)
	P	-82456	97189	13625	-27710	18668	-3289	103416	69757	161950
		(-29 73)	(49 88)	(-4 66)	(-9 95)	(7 44)	(-1 22)	(38 86)	(18 87)	(58 40)
	Y	-33 22	102 15	-48 69	-1 17	4 67	-35 15	40 54	32 45	61 28
		(-14 82)	(53 50)	(-16 61)	(-0 47)	(1 92)	(-752 67)	(19 05)	(12 02)	(27 34)
OILSEEDS										
	A	381	458	4412	5556	8213	-1631	-4321	3438	9630
		(3 52)	(4 08)	(37 83)	(34 56)	(37 97)	(-5 46)	(-15 31)	(-14 39)	(88 98)
	P	902	1402	3685	-425	17207	-8965	-1096	-935	11775
		(20 44)	(26 38)	(54 86)	(-4 08)	(172 48)	(-32 98)	(6 01)	(-5 46)	(266 88)
	Y	0 67	1 01	0 72	-1 86	4 49	-2 65	0 71	0 75	3 84
		(16 46)	(21 30)	(12 52)	(-28 74)	(97 39)	(-29 12)	(11 00)	(10 47)	(94 34)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

show a decreasing trend. There is an overall increase in area under cereals, cash crops and oilseeds when they respectively increased by 120,933 hectares (66.66 per cent), 3,018 hectares (24.39 per cent) and 9,630 hectares (88.98 per cent) while the area under pulses decreased by 34,827 hectares (40.62 per cent) in the same period. The production of all those crops has also increased which have increased their area. The increase was 463,275 metric tonnes (273.27 per cent) for cereals, 161,950 metric tonnes (58.40 per cent) for cash crops and 11,775 metric tonnes (266.88 per cent) for oilseeds in the forty years. The production of pulses decreased by 6,682 metric tonnes (8.80 per cent) in the same period. As far as yield is concerned it has recorded an overall increase for all the crops. The overall increase during 1950-90 in yield under cereals was recorded as 11.59 quintals per hectare (124.08 per cent), under pulses 4.74 quintals per hectare (53.55 per cent), under cash crops 61.28 quintals per hectare (27.34 per cent) and under oilseeds (3.84 quintals per hectare (94.34 per cent). The periodwise variation in area, production and yield is given in Table XXV and its trends is shown in Fig. 32.

6.15 Western Uttar Pradesh

The variations in area, production and yield of major crops of whole Western Uttar Pradesh can be seen from Table XXVI and its trend can be seen from Fig. 33. The Table reveals that Western Uttar Pradesh experiences an increasing trend in the area in all the quinquennial periods except in 1985-90 where it decreased by 396,951 hectares (8.73 per cent). In the first quinquennial period, it increased by 181,636 hectares (5.78 per cent) in 1950-55, by 314 hectares (0.009 per cent) in 1955-60, by 16,809 hectares (0.50 per cent) in 1960-65, by 784,325 hectares (23.40 per cent) in 1965-70, by 79,280 hectares (1.92 per cent) in 1970-75, by 234,629 hectares (5.59 per cent) in 1975-80 and 107,711 hectares (2.42 per cent) in 1980-85. The overall increase between 1950-1990 in the cereal area was of the magnitude of 1,007,753 hectares (32.08 per cent). The area under pulses on the other hand shows a decreasing trend. The area under pulses decreased in all the periods except in 1955-60 and 1980-85 where it increased by 354,037 hectares (33.73 per cent) and 28,988 hectares (6.34 per cent) respectively. The highest decrease in area under pulses by 388,307 hectares (33.21 per cent) was recorded in 1965-70. The overall decrease in area under pulses from 1950-90 was about 781,120 hectares (67.48 per cent). The area under cash crops shows a consistently positive growth. It increased by 92,128 hectares (19.42 per cent) in 1955-60, by 156 hectares (0.02 per cent) in 1960-65, by 45,154 hectares (7.97 per cent) in 1965-70, by 40,903 hectares (6.68 per cent) in 1970-75, by 87,500 hectares (13.40 per cent) in 1975-80, by 48,651 hectares (6.57 per cent) in 1980-85 and by 75,248 hectares (9.54 per cent) in 1985-90. The overall increase in area under cash crops from

TABLE XXVI

Variations in area, production and yield of major crops in Western Uttar Pradesh

CROPS		1950-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	1950-90
CEREALS										
	A	181636	314	16809	784325	79280	234629	107711	-396951	1007753
		(5 78)	(0 009)	(0 50)	(23 48)	(1 92)	(5 58)	(2 42)	(-8 73)	(32 08)
	P	229936	51537	441945	2144162	-218899	1255319	237356	511501	6812857
		(9 60)	(1 96)	(16 52)	(68 79)	(-4 16)	(24 89)	(38 06)	(5 88)	(284 64)
	Y	0 27	0 16	1 28	3 42	-0 76	2 20	4 71	3 29	14 57
		(3 54)	(2 .2)	(15 90)	(36 65)	(-5 96)	(18 34)	(33 19)	(17 40)	(191 20)
PULSES										
	A	-107901	354037	-234450	-388307	-221861	-102284	28988	-109342	-781120
		(-9 32)	(33 73)	(-16 70)	(-33 21)	(-28 41)	(-18 29)	(6 34)	(-22 51)	(-67 48)
	P	41491	195284	-75966	-90448	-305401	-220423	119293	-88212	-424382
		(4 96)	(22 24)	(-7 07)	(-9 07)	(-33 68)	(-36 65)	(31 31)	(-17 63)	(50 74)
	Y	1 14	-0 72	0 88	-3 09	-0 86	-2 41	1 95	0 65	3 72
		(15 78)	(-8 61)	(11 51)	(36 26)	(-7 40)	(-22 41)	(23 38)	(6 31)	(51 52)
CASH CROPS										
	A	-20345	92128	156	45154	40903	87500	48651	75248	369395
		(-4 11)	(19 42)	(0 02)	(7 97)	(6 68)	(13 40)	(6 57)	(9 54)	(74 69)
	P	43314	5569579	1805997	1678356	4961680	3806149	4467221	3549636	25881932
		(0 31)	(40 71)	(9 38)	(7 97)	(21 82)	(13 74)	(14 18)	(9 86)	(189 81)
	Y	12 75	51 42	31 78	0 01	53 00	1 25	30 38	1 36	181 69
		(4 62)	(17 82)	(9 35)	(0 002)	(14 25)	(0 29)	(7 13)	(0 29)	(65 89)
OILSEEDS										
	A	125634	-86839	77341	16494	68720	-42346	64904	30974	254882
		(121 94)	(-37 97)	(54 53)	(7 52)	(29 16)	(-13 91)	(24 77)	(9 47)	(247 40)
	P	11469	23808	67155	-24491	60756	-31477	84434	26665	218319
		(18 65)	(32 63)	(69 40)	(-14 94)	(43 57)	(-15 72)	(50 04)	(10 53)	(355 08)
	Y	-2 77	3 63	0 65	-1 56	0 66	-0 14	1 31	0 07	1 31
		(-46 47)	(113 79)	(9 53)	(-20 88)	(11 16)	(-2 13)	(20 37)	(0 90)	(21 97)

A = Area

P = Production

Y = Yield

Note Figures in brackets are the percentage increase and decrease in area, production and yield to the total area, production and yield of previous years

1950-1990 is about 369,395 hectares (74.69 per cent). The area under oilseeds shows an increasing trend except in 1955-60 where it decreased by 86,839 hectares (37.97 per cent) and in 1975-80 where it decreased by 42,346 hectares (13.91 per cent). The highest increase in area under oilseeds was recorded in 1950-55, by 125,634 hectares (121.94 per cent). There is about 254,882 hectares (247.40 per cent) total increase in area under oilseeds between 1950-1990.

As against area, the production of cereals shows an increasing trend throughout the study period except in 1970-75 when it decreased by 218,899 metric tonnes (4.16 per cent). In the first quinquennial period, i.e. 1950-55, it increased upto a magnitude of 229,926 metric tonnes (9.60 per cent), by 51,537 metric tonnes (1.96 per cent) in 1955-60, by 441,945 metric tonnes (16.52 per cent) in 1960-65, by 2,144,162 metric tonnes (68.79 per cent), by 1,255,319 metric tonnes (24.89 per cent) in 1975-80, by 237,356 metric tonnes (38.06 per cent) in 1980-85 and by 511,501 metric tonnes (5.88 per cent) in 1985-90. The production of pulses shows a mixed trend. The highest increase in production under pulses was recorded as 195,284 metric tonnes (22.24 per cent) in 1955-60 in whole of the Western Uttar Pradesh. While the highest decrease in production under the same crop was observed during the period of 1970-75 when it decreased by 305,401 metric tonnes (33.21 per cent). But there is an overall decrease in the production of

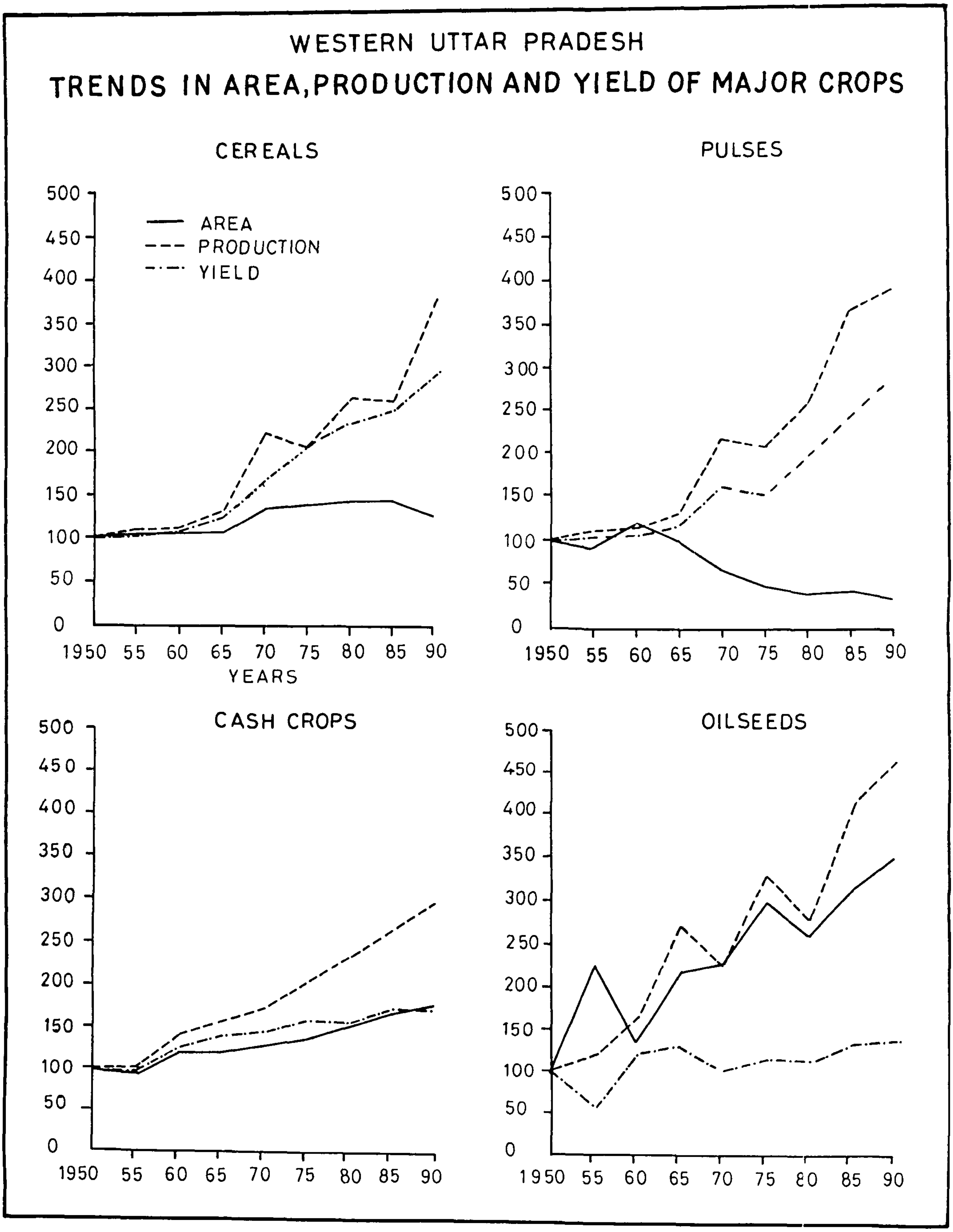

WESTERN UTTAR PRADESH
TRENDS IN AREA, PRODUCTION AND YIELD OF MAJOR CROPS
CEREALS
AREA
PRODUCTION
YIELD
YEARS
PULSES
CASH CROPS
OILSEEDS
500
450
400
350
300
250
200
150
100
50
0
1950
55
60
65
70
75
80
85
90

FIG.33

pulses when it decreased by 424,382 metric tonnes (50.74 per cent) during forty years. The production of cash crops recorded a consistently increasing trend. The highest increase was seen upto a magnitude of 5,569,579 metric tonnes (40.71 per cent) in the period of 1955-60. In all the forty years under consideration, the production of cash crops increased by 25,881,932 metric tonnes (189.81 per cent) in the region. The production of oilseeds increased in all the periods except in the periods of 1965-70 and 1975-80 when it decreased by 22,491 metric tonnes (14.94 per cent) and 31,477 metric tonnes (15.72 per cent) respectively. The highest increase in production under cash crops was seen during the period of 1980-85 when it increased by 84,434 metric tonnes (50.04 per cent). However, there is an overall increase in forty years of about 218,319 metric tonnes (355.08 per cent).

The yield of cereals shows a positive trend except in 1970-75 when it decreased by 0.76 quintals per hectare. The overall increase in yield under cereals is about 14.57 quintals per hectare (191.20 per cent) in the region. The yield of pulses shows a mixed trend. The maximum increase in yield in pulses, i.e. 1.95 quintals per hectare (23.38 per cent) was recorded in the period of 1980-85. The maximum decrease in yield of 3.09 quintals per hectare (36.26 per cent) under pulses was observed in the period of 1965-70. But on the whole it shows an increase in yield by 3.72 quintals per hectare (51.52 per cent). The yield of cash crops shows an increasing trend throughout the study period. The maximum increase in yield by 53.00 quintals per hectare (14.25 per cent) was observed during the period of 1970-75. The yield of oilseeds shows a mixed picture, but on the whole, there is an increase in its yield by 1.31 quintals per hectare (21.97 per cent).

CHAPTER VII

SPATIO - TEMPORAL DEVELOPMENT OF AGRICULTURE WITH SPECIAL REFERENCE TO CROP PRODUCTIVITY

7.0 The term productivity has been used in different meanings and has arousd many conflicting interpretations. Sometimes it is considered as the overall efficiency with which a production system works, as on the other it is defined as a ratio of output to resources.

According to Shafi, productivity is generally used to express the power of agriculture in a particular region to produce crops, no matter whether that power is natural as due to the efforts of man. It is not a synonym of 'fertility', because fertility denotes the ability of soil to produce all the essential plant nutrients in available form and suitable balance for the plant growth[1]. Dewett explains it as "Productivity expresses the varying relationship between agricultural output and one of the major inputs, like land or labour or capital, other complimentary factors remaining the same. It may be borne in mind that productivity is physical rather than a value concept"[2].

Agricultural productivity may be defined as the ratio of the index of total agricultural output to the index of

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1. **Shafi, M.** Agricultural productivity and Regional Imbalances, p.148, 1984, New Delhi
2. **Dewett, K.K., and Singh G.,** Indian Economics, p.66, 1926, Delhi

total input used in farm production. The measurement of agricultural productivity is not a simple task as it involves a relationship between inputs in agricultural production. Stamp while attempting to measure crop productivity per unit area emphasized that areal differences in crop productivity are the result partly of natural advantages of soil, and climate and partly of farming efficiency[3].

There are many geographers and economists in and around the world who have made an attempt to analyse the agricultural productivity. Thompson[4] (1926) while measuring the relative productivity of British and Danish farming emphasized and expressed it in terms of gross output of crops and livestock.

Ganguli[5] (1938) in his study of the Ganges valley presented a theoretical discussion for assessment of agricultural productivity. Firstly, he took into account the area under any crop(A) in a particular unit area belonging to a certain region. This area is expressed as a proportion of the total cropped area under all the selected crops. secondly, he tried to obatin the index number of yield. This he did by

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3. **Stamp, L.D.**, Our Developing World, London, 1960, p.108

4. **Thompson, J.P.**, "The productivity of British and Danish Farming", Journal of Royal Statistical Society", 89, Part 2, 1926, p.218

5. **Ganguli, B.N.**, Trends in Agricultural and population in the Ganges Valley, 1938, London, p.93

dividing the yield per hectare for the entire region as the standard. This yield may be expressed as a percentage and this percentage he termed as yield index number. Thirdly, the population of the area under crop(A) and the corresponding index number of yield were multiplied. The product thus obtained indicates actually an index of contribution of crop 'A' to the productivity of the unit area considered.

Kendall (1939)[6] treated the productivity measurement as a mathematical problem and initiated a system of farm co-efficients of (i) productivity, (ii) ranking (iii) money value and (iv) starch equivalent or energy. According to him, the productivity coefficient and the ranking coefficient are concerned only with the yield per unit area, but are not in any way weighted according to the volume of production. Kendall, therefore, evolved a measure of crop productivity by using index number technique. In this technique the yield of different crops should be expressed in terms of some common units. For this purpose he pointed out two common units: (i) money value 'as expressed in price' and (ii) energy 'as expressed in starch equivalent'.

Kendall's money value coefficient has some difficulties. Firstly, the price list of some of the vegetables

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6. **Kendall, M.G.,** "The Geographical Distribution of Crop productivity in England", Journal of Royal Statistical Society, 1939, p.162

are not available and secodnly, large variation in the price of agricultural produce from the area where it is produced to the other areas of consumption. Kendall, therefore, suggested starch equivalent as the most suitable unit. While calculating a coefficient based on starch equivalent it should be decided: (a) whether the gross starch equivalent or net equivalent of various crops should be considered. Net energy refers to the amount of energy for work and body building whereas, a gross figure includes the energy used in digestive process of the consuming animals and similar non-realisable forms. Kendall suggested that production of energy be preferred as the gross energy.

Hirsch (1943)[7] has suggested 'Crop Yield Index" as the basis of productivity measurement. It expresses the average of the yields of various crops on a farm or in a locality relative to the yields of the same crops on another farm in a second locality.

Stamp (1958)[8] has considered colorific value of farm production in measuring the agricultural productivity. He calculated the 'Stantard Nutrition Unit' (SNU) by converting all the food production per acre in calories. Taking into consideration the age structure of the population, the range of

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7. **Hirsch, H.G.,** "Crop Yield Index" Journal of Farm Economics, 25(3), 1943, p.583

8. **Stamp, L.D.,** "The Measurement of Land Resources", Geographical Review, 48(1), 1958, pp.110-116

occupations, the weight and height of the people living under the climatic conditions of northwestern Europe, the average is is 2460 calories a day or about 9,00,000 calories per year.

Shafi (1960)[9] has calculated the agricultural efficiency in Uttar Pradesh by using Kendall's 'ranking coefficient", taking into account eight food crops grown in each of the forty eight districts of the state.

Mackenzie (1962)[10] has measured the efficiency of production in Canadian agriculture by using the coefficient of output relative to input. He mentions that concept of productivity measurement is difficult to define and even more difficult to quantify.

Commen (1962)[11] while working out the trends of productivity in agriculture of the state of Kerala (India) has measured productivity on the basis of yield per acre.

Chatterji and Maitreya (1964)[12] have determined

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9. **Shafi, M.,** "Measurement of Agricultural Efficiency'in Uttar Pradesh", Economic Geography", 36(4), 1960, pp.296-305

10. **Machenzie, W.,** "The impact of Technological change on the Efficieny of Production in Canadian Agriculture", Canadian Journal of Agricultural Economics, No.1, 1962, p.41

11. **Commen, M.A.,** "Agricultural Productivity Trends in Kerala", Agricultural Sitaution in India, 17(4), 1962, pp.333-36

12. **Chatterji, A. and Maitreya, P.,** "Some Aspects of Regional variation in Agricultural Productivity and Development in West Bengal", Indian Journal of Agricultural Economics, 19(1), 1964, pp.207-212

the levels of agricultural development and productivity during 1950-51 to 1957-58 in the state of West Bengal taking two crops (rice and jute) into consideration. They utilized the acre yield figures for this purpose.

Enyedi (1964)[13] while describing geographical types of agriculture in Hungary used the following formula for determing agricultural productivity:

$$\frac{Y}{Y_n} \approx \frac{T}{T_n}$$

Where

Y = total yield of the respective crop in the unit area.

Y_n = total yield of the crop at the national level

T = total cropped area of the unit and

T_n = total cropped area at the national level.

Khusro (1965)[14] has linked assessment of productivity with the output per unit of a single input and output per unit of cost of all inputs in the agricultural production.

Beside these, there are a number of other social scientists have adopted different methods for the assessment of agricultural productivity. But W.Y.Yang (1965) has based his

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13. **Enyedi, G.Y.**, "Geographical Types of Agriculture", Applied Geography in Hungary, Budapest, 1964,p.61

14. **Khusro, A.M.**, "Measuremnt of Productivity at Macro and Micro level", Journal of the Indian Society of Agricultural Statistics, 27(2), 1965, p.278

analysis on sound footing by calculating the yield of different crops in a farm and comparing it with the average crop yield of the whole region under study. Later on a value in percentage is obtained by dividing the yield per hectare of a crop in a particular farm by the average yield of the crop in the entire region. The value obtained is multiplied by 100 and gives the index number. By considering the area, devoted to each crop as a weight and multiplying this by percentage index, the produce are obtained and by adding the products and dividing the sum of the products by the total cropped area in the farm, the average crop index is obtained for the particular farm, using crop as weight.

All these studies are aimed to find ways and means for increasing agricultural productivity. The basic objective of agricultural planning in India is to attain self sufficiency in agricultural production. Therefore, for researhers it is important to measure the level of agricultural productivity on a micro level in different regions of the country and to study as to how for the objective of agricultural planning for the production of different crops has been achieved.

In the present study the productivity have been calculated on the basis of Yang's Crop Yield formula for the two periods of time, i.e., 1950-51 and 1990-91. All the major agricultural crops grown in the study region are categorised into four majors groups: (a) Cereals, which include rice, wheat, maize, barley, Jowar and bajra, (b) pulses including blackgram (urd), greengram(moong), lentil(masoor), gram, peas and pigeonpeas, (c) cash crops, such as sugarcane and potatoes and (d) oilseeds include mustard, til and groundnut.

The data has been collected from the published records of the Directorate of Agricultural Statistics and crop Insurance, Krishi Bhawan and from the Institute of State Planning, Jawahar Bhavan, Lucknow, Uttar Pradesh for the year 1950-51 and 1990-91, taking district as a unit. The districtwise indices of crop productivity were computed according to the methodology given by Yang.

For calculating the crop yield Index for a district, the average yield of each crop grown in the region, i.e, Western Uttar Pradesh must be known. The percentage value of the crop yield in the district is then calculated by dividing the yield per hactare of the crops in whole Western Uttar Pradesh. This calculated value gives the index number of the crop yield in the district. This percentage value of the crop yield in the district is multiplied by the area under the crop in the district. The products which come were added and divided by the sum total of area under different crops in a district. The avearge index is thus obtained which is the desired crop index of a district, using crop as a weight.

7.1 The productivity of different groups of crops, i.e, Cereals, pulses, cash crops and oilseeds for the year 1950-51 has been worked out.

7.1.1 Productivity Regions (1950-51) Cereals

Cereal crops acquire very important position in the agriculture of Western Uttar Pradesh. They occupying 3,211,427 hectares of cultivated area which accounts for 65.50 per cent of the total cropped area of the region. Productivity regions of cereals are shown in Fig.34 and the number of districts in each category of high, medium and low productivity with their productivity indices are given in Table-XXVII.

Table-XXVII

Number of districts under different productivity regions with their indices (1950-51)

	CEREALS		PULSES		CASH CROPS		OILSEEDS		COMPOSIT INDEX	
CATEGORY	Indices	No of Districts	Indices	No of Districts	Indices	No of Districts	Indices	No of Districts	Indices	No of Districts
High	Above 95 03	2	Above 94 27	6	Above 105 07	4	Above 98 94	1	Above 396 85	3
Medium	Between 84 90-95 03	6	Between 84 27-94 27	1	Between 81 11-105 07	5	Between 90 59-98 94	3	Between 376 98-396 85	4
Low	Below 84 60	5	Below 84 27	6	Below 81 11	4	Below 90 59	9	Below 376 98	6

It may be seen from the Figure that there are two areas of high productivity lying separately from each other on the two extremities, one in the north and the other in the south. These two areas of high productivity are separates by medium productivity areas which form extensive block in the

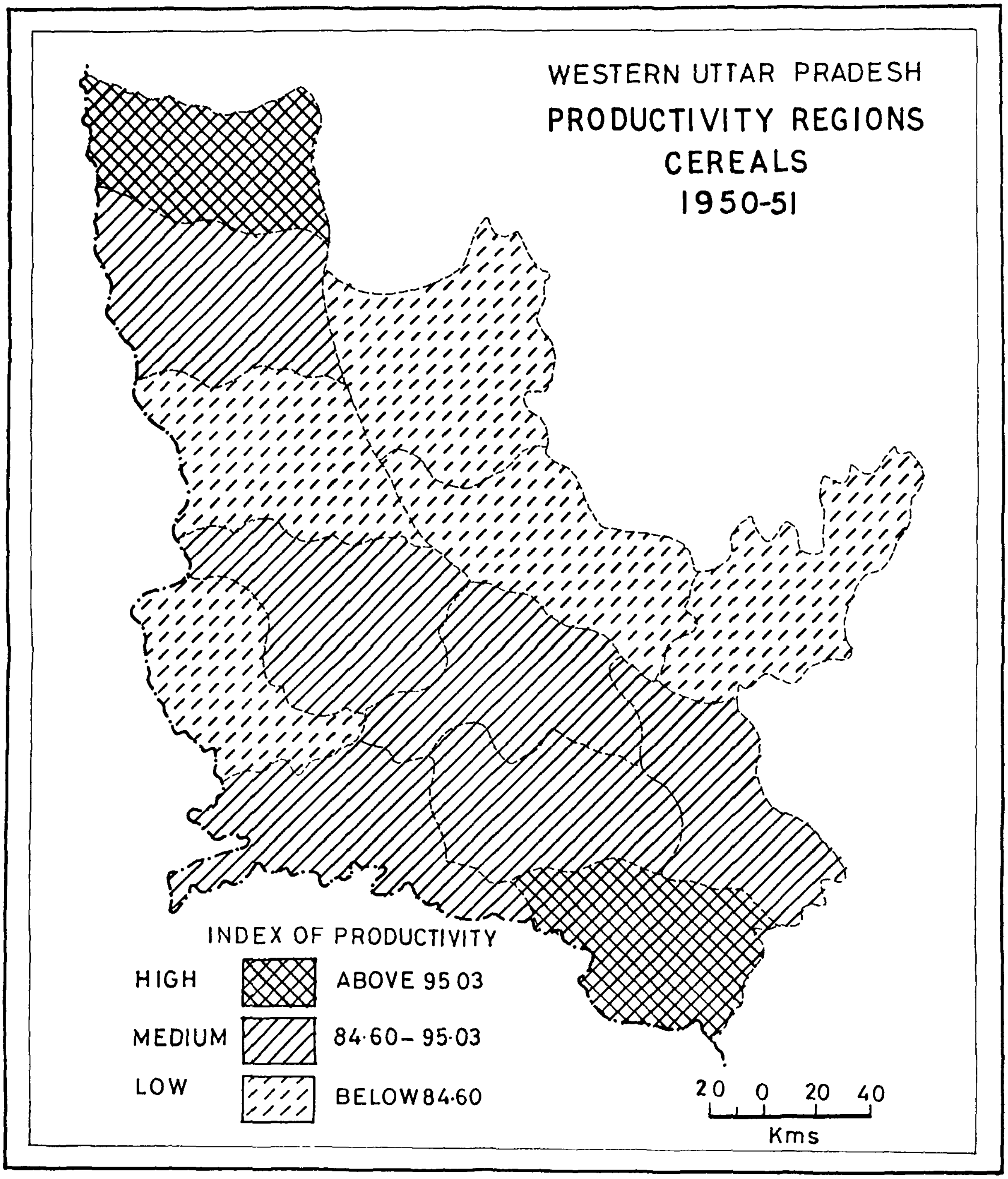
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
CEREALS
1950-51
INDEX OF PRODUCTIVITY
HIGH
ABOVE 95 03
MEDIUM
84·60– 95·03
LOW
BELOW 84·60
20 0 20 40
Kms

FIG.34

central and western parts of the study region. A small area of low productivity stretches on the northwestern parts of the study area.

Muzaffarnagar and Etawah districts with a rating of above 95.03 make high productivity area for cereals. These districts altogether cover an area of 355,922 hectares or 11.08 per cent of the total area under cereals in the region.

Medium productivity region of cereals having productivity indices between 84.60 to 95.03 includes six districts, namely Mainpuri, Farrukhabad, Etah, Aligarh, Agra and Merrut. All these districts together include 1,508,870 hectares or 46.98 per cent of the total cropped area under cereals.

Low productivity region of cereals spreads over the districts of Bulandshahr, Budaun, Mathura, Shahjahanpur and Moradabad. The low prodcutivity region with indices below 84.60 covers an area of 1,346,635 hectares accounting for 41.93 per cent of the total cropped area under cereals in Western Uttar Pradesh.

7.1.2 Productivity Regions (1950-51): Pulses

Pulses occupy 1,169,765 hectares or 23.86 per cent of the total cropped area of the region. The high, medium and low productivity region of pulses are shown in Figure 35 and their areal strengths is given in Table-XXVII. From the Figure, it may be seen that the productivity of pulses in Western Uttar

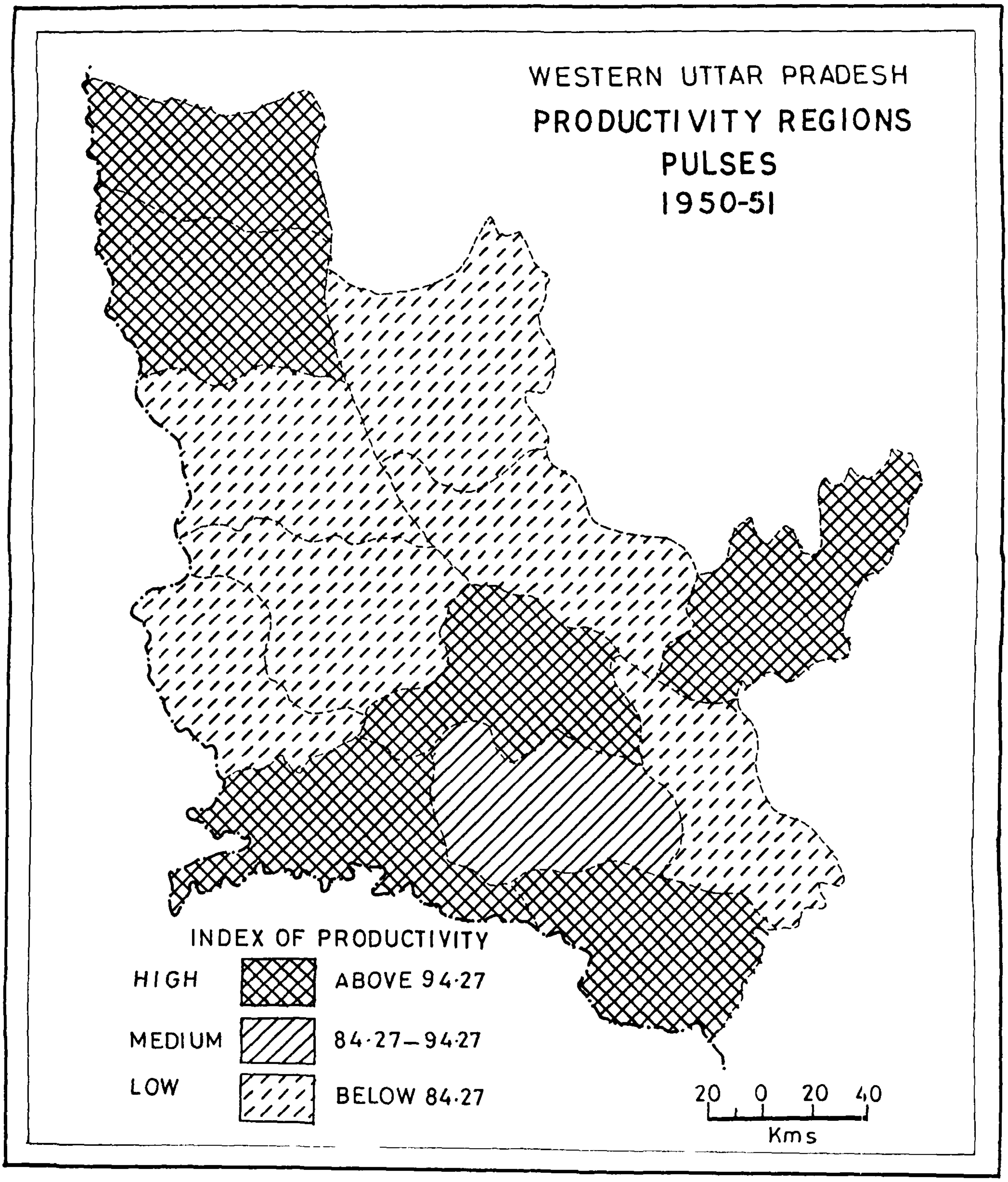
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
PULSES
1950-51
INDEX OF PRODUCTIVITY
HIGH
ABOVE 94·27
MEDIUM
84·27–94·27
LOW
BELOW 84·27
20 0 20 40
Kms

FIG.35

Pradesh was not high in 1950-51 as only one small patch on the northern part of the study area carries high productivity. The medium productivity area for pulses makes a distinct region lying on the western and northeastern part of the study area. There is no such area in Western Uttar Pradesh where pulses may have poor productivity.

A little less than half of the region falls under high productivity with indices above 94.27 and is comprised of the districts of Muzaffarnagar, Merrut, Shahjahanpur, Etawah, Etah and Agra.

Medium productivity region of pulses is seen in Mainpuri district which has a productivity indices between 84.27 to 94.27. The medium productivity region covers an area of 72,349 hectares which accounts to 6.18 per cent of the total cropped area of pulses in Western Uttar Pradesh.

Low productivity region of pulses with indices of below 84.27 occupies 555,146 hectares or 47.45 per cent of the total cropped area under pulses and spreads over the districts of Farrukhabad, Mathura, Aligarh, Bulandshahr, Moradabad and Budaun.

7.1.3 Productivity Regions (1950-51): cash crops

Cash crops occupy 432,746 hectares or 8.92 per cent of the total cropped area of Western Uttar Pradesh. The productivity regions of cash crops are shown in Figure 36 and

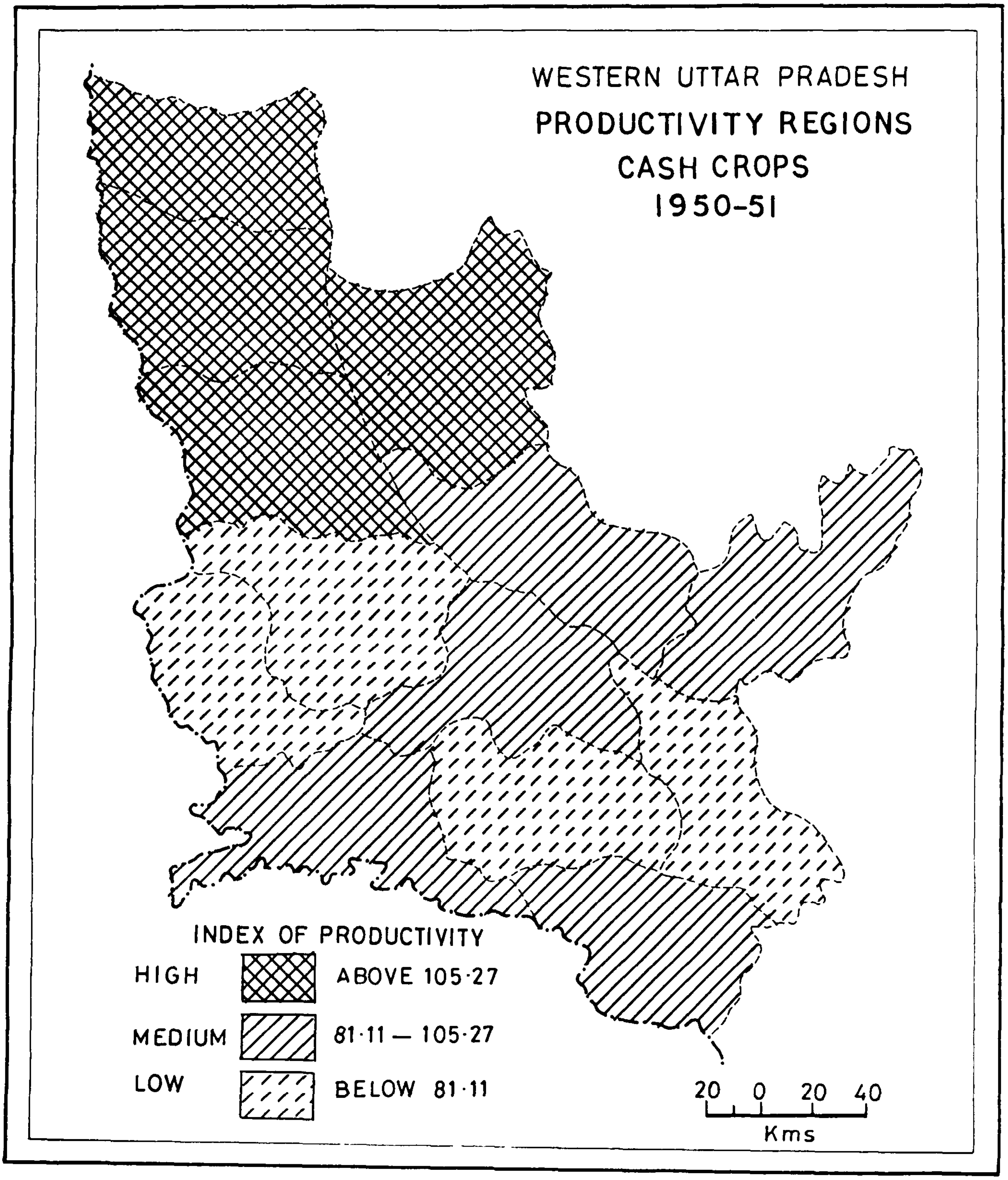
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
CASH CROPS
1950-51
INDEX OF PRODUCTIVITY
HIGH
ABOVE 105·27
MEDIUM
81·11 — 105·27
LOW
BELOW 81·11
20 0 20 40
Kms

FIG.36

their indices are given in Table-XXVII. The northern part of the study area makes a distinct region of high productivity. This region with a productivity indices above 105.07 spreads over four districts namely, Muzaffarnagar, Merrut, Moradabad and Bulandshahr. In all about two-third area under cash crop has high productivity.

The medium productivity area is stretches over the central, eastern and southern parts of the study region. This region of medium productivity spreads over the districts of Shahjahanpur, Budaun, Etawah, Etah and Agra. These districts altogether covers an area of 89,237 hectares or about one-fifth of the cropped area of cash crops in Western Uttar Pradesh. This region is having productivity indices between 81.11 to 105.07.

There are two patches of low productivity on the western and eastern parts of the study region of cash crops. These both regions cover the districts of Mainpuri, Farrukhabad, Mathura and Aligarh. It covers an area of 68,118 hectares which accounts for 15.56 per cent of the total cropped area of the study region. The productivity indices of this region are below 81.11.

7.1.4 Productivity Regions (1950-51): Oilseeds

Oilseeds occupy only 83,499 hectares or 1.70 per cent of the total cropped area of western Uttar Pradesh. The productivity regions of oilseeds are shown in Figure 37 and

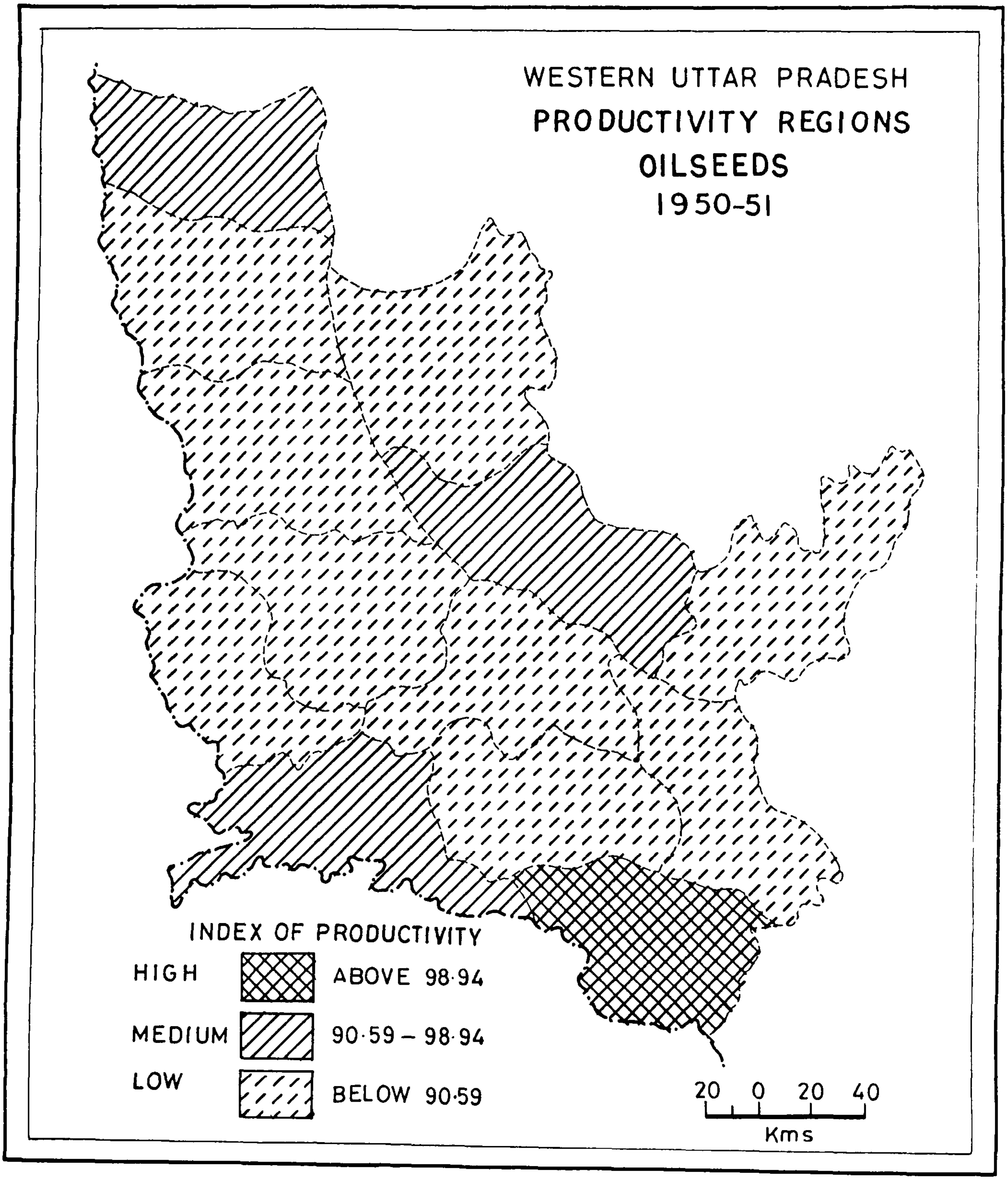
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
OILSEEDS
1950-51
INDEX OF PRODUCTIVITY
HIGH
ABOVE 98·94
MEDIUM
90·59 – 98·94
LOW
BELOW 90·59
20 0 20 40
Kms

FIG. 37

their ratings are tabulated in Table-XXVII. The high productivity region having productivity indices of above 98.94 covers an area of 9,212 hectares or 11.03 per cent of the total cropped area under oilseeds in the study region and lies in Etawah district.

The areal extent of average oilseeds productivity is high, spreading in the central and north-eastern parts of the study area. Districts of Muzaffarnagar, Budaun and Agra are placed under medium productivity of oilseeds. Altogether they cover an area of 17,261 hectares which is about one-fifth of the total cropped area of oilseeds in the study region. The productivity indices of the medium productivity region ranges between 90.59 and 98.98.

The low productivity areas of oilseeds lie scattered in the extreme south, north and eastern parts of the study area and do not make any distinct region. This region of low productivity is recorded in the districts of Etah, Mathura, Bulandshahr, Moradabad, Farrukhabad, Shahjahanpur, Aligarh, Mainpuri and Merrut. It is an extensive area accounting for about two third of the total area under oilseeds.

7.1.5 Productivity Regions (1950-51): Composit Index

The overall productivity indices for each district are given in Table-XXVII and Fig.38. A regional analysis of productivity based on composit index reveals the existence of a small patch of high productivity in the extreme north of the

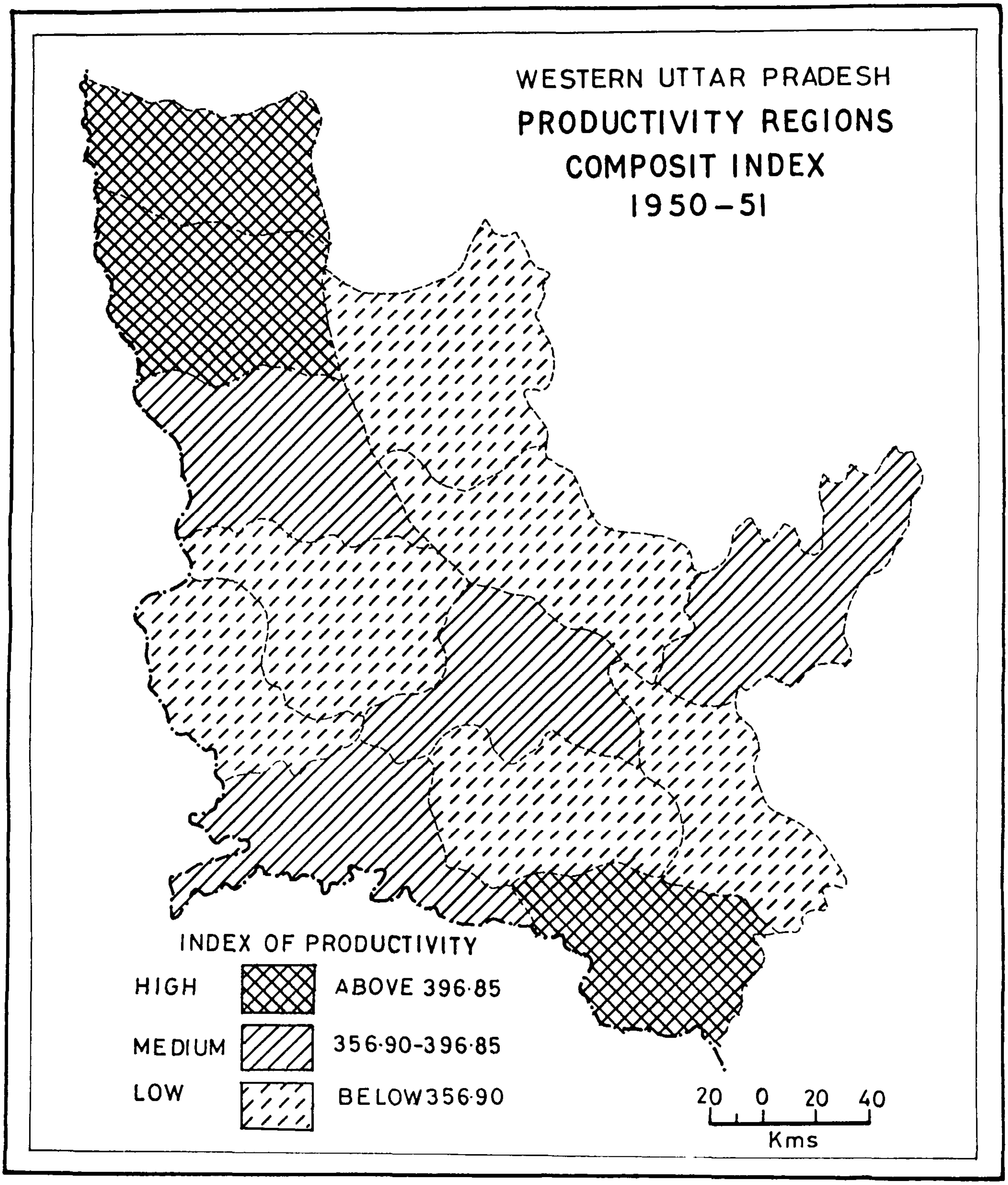
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
COMPOSIT INDEX
1950-51
INDEX OF PRODUCTIVITY
HIGH
ABOVE 396·85
MEDIUM
356·90-396·85
LOW
BELOW356·90
20 0 20 40
Kms

FIG.38

study area. This small patch of high productivity with the indices above 396.85 includes the districts of Merrut, Etawah and Muzaffarnagar. All these districts together have an area of 1,112,653 hectares which accounts for 22.89 per cent of the total cropped area of the study region.

The medium productivity areas lie scattered over the whole region mainly in its central. southern and eastern parts. The districts which recorded medium productivity are Bulandshahr, Etah, Shahjahanpur and Agra. The productivity indices range between 356.90 and 396.85. This region covers an area of 1,485,141 hectares which is 30.29 per cent of the total cropped area of the study region.

There are three small patches of low productivity, one small patch is lies on the western part, the other in the north eastern part and a third one in the eastern part of the study area. This region of low productivity extends over the districts of Moradabad, Budaun, Farrukhabad, Mathura, Aligarh and Mainpuri. The productivity indices of low productivity are below 356.90. This region covers an area of 2,304,643 hectares which is 47.01 per cent of the total cropped area of the study region.

7.2 The agricultural productivity regions of different groups of crops i.e., cereals, pulses, cash crops and oilseeds for the year 1990-91 has been worked out below.

7.2.1 Productivity Regions (1990-91): Cereals

Cereals are the most important crops grown in Western Uttar Pradesh. These crops occupy 4,678,246 hectares of land accounting for 72.60 per cent of the total cropped area of Western Uttar Pradesh. The productivity regions of cereals are shown in Fig.39 and the number of districts in each category, i.e. high, medium and low productivity with their productivity indices are given in Table-XXVIII.

Table-XXVIII

Number of districts under different productivity regions with their indices (1990-91)

	CEREALS		PULSES		CASH CROPS		OILSEEDS		COMPOSIT INDEX	
CATEGORY	Indices	No of Districts	Indices	No of Districts	Indices	No of Districts	Indices	No of Districts	Indices	No of Districts
High	Above 102 11	7	Above 117 10	2	Above 117 03	3	Above 120 64	2	Above 433 97	5
Medium	Between 84 16-102 11	6	Between 96 87-117 10	5	Between 96 97-117 03	6	Between 90 41-120 64	8	Between 376 98-433 97	7
Low	Below 84 16	1	Below 96 87	7	Below 96 97	5	Below 90 41	4	Below 376 98	2

The districts of high productivity indices occupy a large distinct region over northwestern part of the study region. This area lies in the Ganga-Yamuna doab. This region covers seven districts of Merrut, Bulandshahr, Muzaffarnagar, Shahjahanpur, Aligarh, Ghaziabad and Agra covering 45.34 per cent of the total area under cereals in the study region. The productivity indices of high productivity region ranges above 102.11.

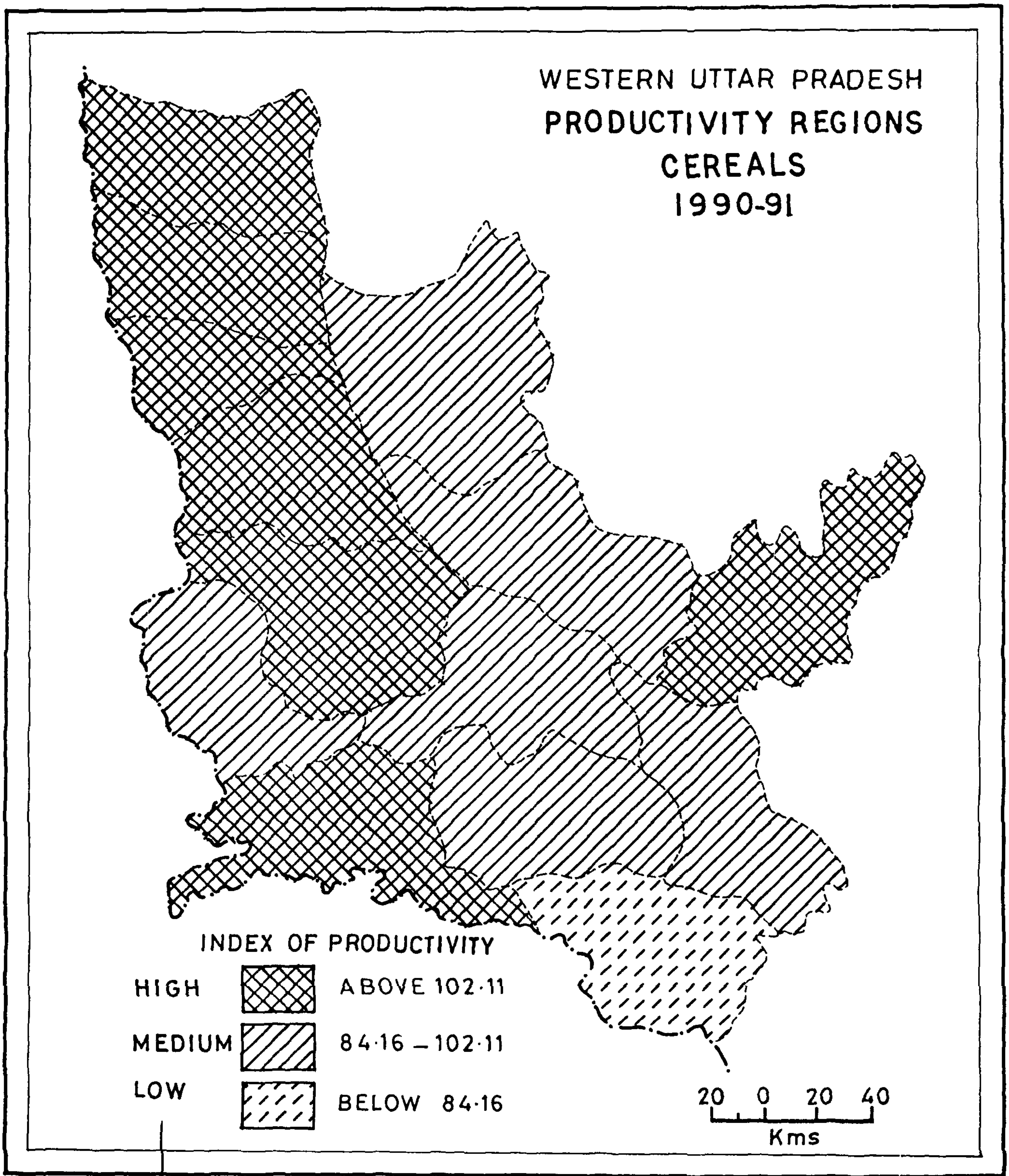
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
CEREALS
1990-91
INDEX OF PRODUCTIVITY
HIGH
ABOVE 102·11
MEDIUM
84·16 – 102·11
LOW
BELOW 84·16
20 0 20 40
Kms

FIG.39

Medium productivity region spreads over six districts of central and northeastern parts of the study region. These districts are *Mathura, Moradabad, Etah, Mainpuri, Farrukhabad and Budaun covering 46.44 per cent of the total* cropped area under cereals in Western Uttar Pradesh. The productivity indices of this region are between 84.16 and 102.11.

District Etawah has low productivity and in terms of area occupies 8.30 per cent of the total area under cereals. It has a productivity indices below 84.16.

7.2.2 Productivity Regions (1990-91): Pulses

Pulses in Western Uttar Pradesh are grown over 365,943 hectares and account for 5.67 per cent of the total cropped area of the region. The productivity indices of pulses are demonstrated in Fig.40 and the indices for various districts are tabulated in Table-XXVIII.

High pulses productivity is seen on the extreme south of the study area. This region of pulses lies in two districts, i.e. Agra and Etawah which have a productivity index above 117.10. These southern districts altogether have an area of 79,611 hectares which is 21.75 per cent of the total area under pulses in Western Uttar Pradesh.

A block of medium productivity is seen on the central and eastern parts of the study area. This region covers

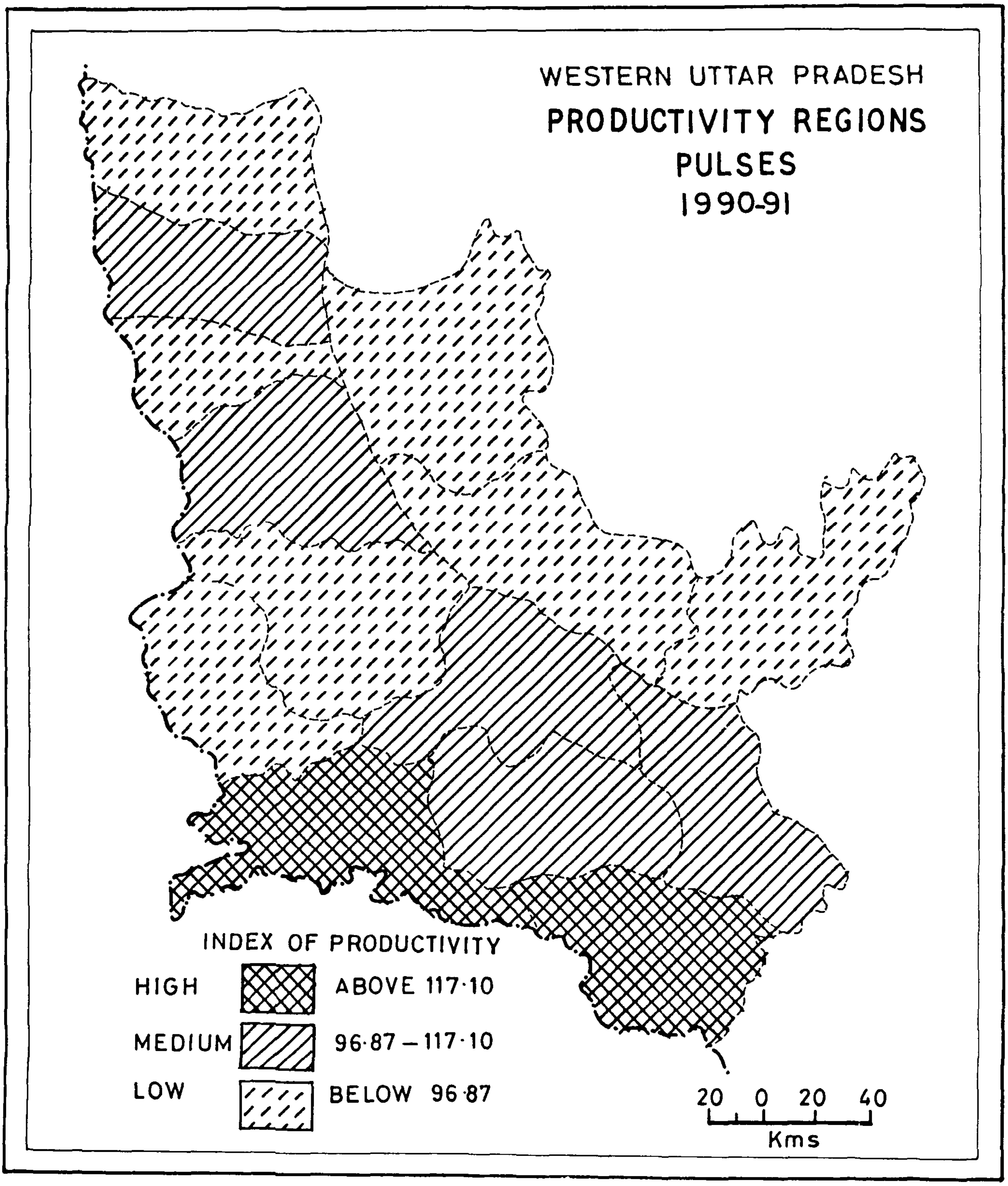
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
PULSES
1990-91
INDEX OF PRODUCTIVITY
HIGH
ABOVE 117·10
MEDIUM
96·87 – 117·10
LOW
BELOW 96·87
20 0 20 40
Kms

FIG. 40

the districts of Bulandshahr, Mainpuri, Farrukhabad, Etah and Merrut with an index ranging between 96.87 and 117.10. These districts of medium productivity cover an area of 122,496 hectares which accounts for 33.47 per cent of the total area under pulses in the study region.

The low productivity of pulses is seen in seven districts namely, Muzaffarnagar, Aligarh, Shahjahanpur, Ghaziabad, Moradabad, Budaun and Mathura where the index value is less than 96.87. Low productivity is seen in 163,756 hectares which is 44.74 per cent of the total area under pulses of Western Uttar Pradesh. The districts of low productivity of pulses are scattered on the northeastern, western and southern parts of the study area.

7.2.3 Productivity Regions (1990-91): Cash crops

Cash crops are the second most important group of crops grown in the study area. The crops occupy 986,751 hectares of area which is 15.31 per cent of the total cropped area of the region. The areal spread of cash crops according to their productivity rating is demarcated in Figure 41 and the index value under each category is tabulated in Table-XXVIII.

It may be seen from the Figure that two small patches of high productivity of cash crops lie on the southern part of the region. Both patches cover the districts of Bulandshahr, Muzaffarnagar and Ghaziabad which together account

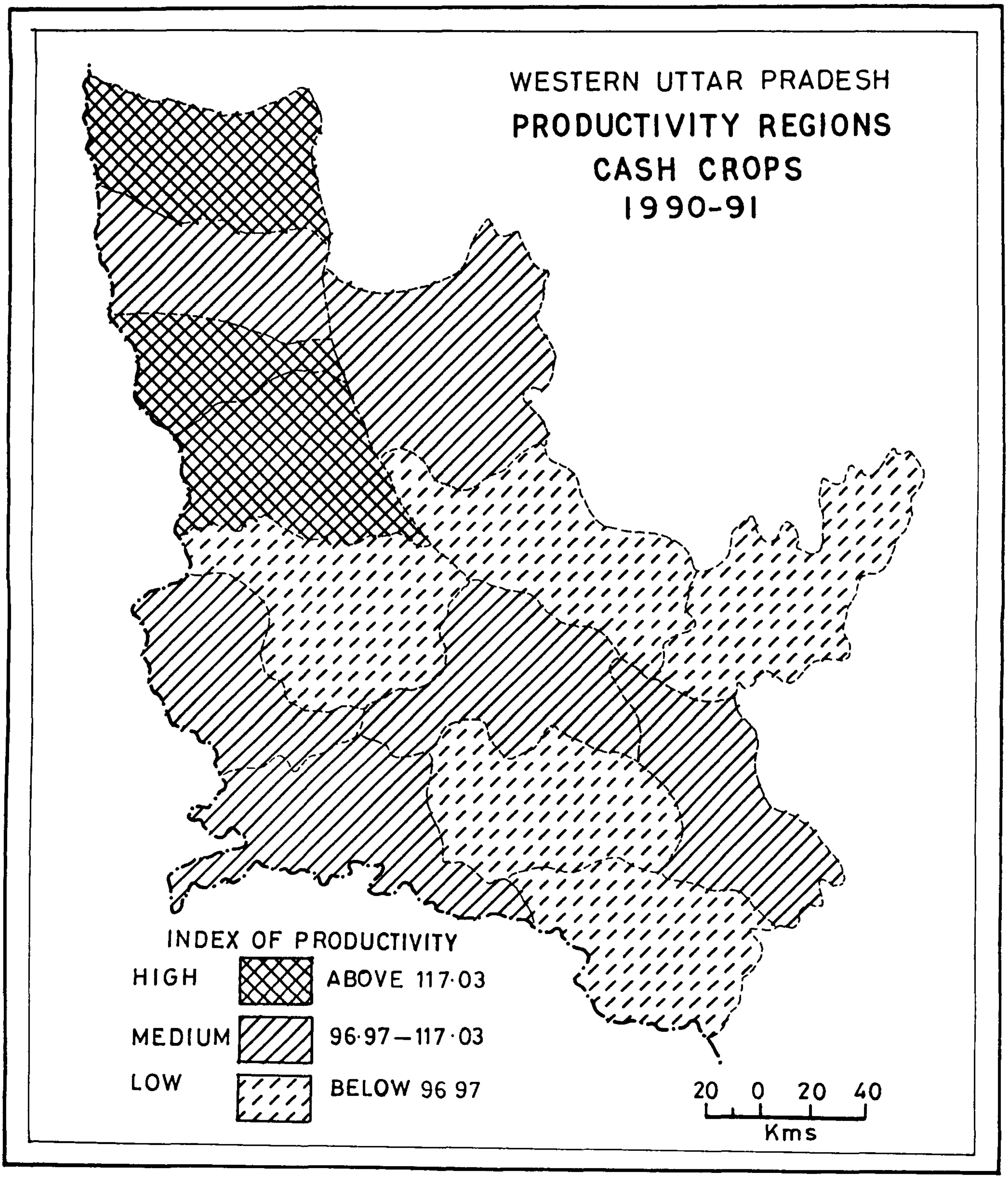
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
CASH CROPS
1990-91
INDEX OF PRODUCTIVITY
HIGH
ABOVE 117·03
MEDIUM
96·97—117·03
LOW
BELOW 96 97
20 0 20 40
Kms

FIG. 41

for 33.10 per cent of the total area under cash crops. The productivity index of high productivity is above 117.03.

The districts of Moradabad, Etah, Mathura, Merrut, Farrukhabad and Agra in the central and western parts of the study area fall under the medium productivity category. The productivity indices of this region range from 96.72 to 117.03. These districts together occupy almost half of the total area devoted to cash crops in the study region.

The low productivity of cash crops with an index value lower than 96.77 is seen in three small patches, one patch is seen on northeastern part, another on the extreme south and a third one lies in the western part of the study area. The districts which belong to this category are Etawah, Mainpuri, Aligarh, Budaun and Shahjahanpur. The low productivity area accounts for 16.91 per cent of the total cash crops area in Western Uttar Pradesh.

7.2.4 Productivity Regions (1990-91): Oilseeds

Oilseeds make the last group of crops grown in Western Uttar Pradesh. They cover an area of 412,084 hectares which is 6.39 per cent of the total cropped area of the region. The productivity regions of oilseeds are shown in Figure 42 and the number of districts under high, medium and low productivity with their index number are mentioned in Table-XXVIII.

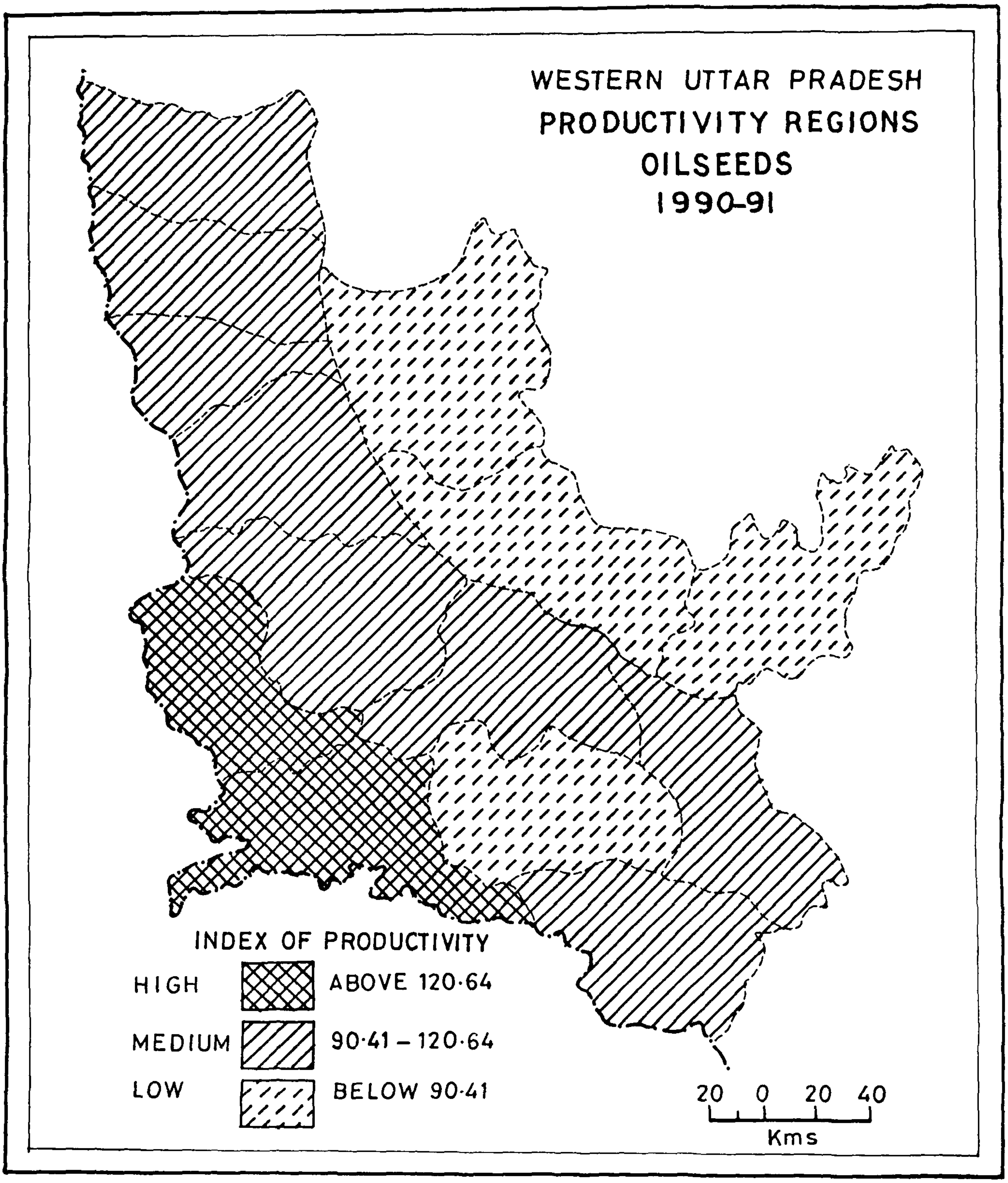
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
OILSEEDS
1990-91
INDEX OF PRODUCTIVITY
HIGH
ABOVE 120·64
MEDIUM
90·41 – 120·64
LOW
BELOW 90·41
20 0 20 40
Kms

FIG.42

Districts Agra and Mathura with an index value above 120.64 have high productivity of oilseeds. These both districts lie on the western part of the study area. The high oilseeds productivity area makes 41.34 per cent of the total area under oilseeds in Western Uttar Pradesh.

Medium productivity of oilseeds covers a large area as a belt stretching from north of the study area through central parts upto northeastern parts of the study region. The region includes the districts of Etah, Aligarh, Merrut, Muzaffarnagar, Bulandshahr, Ghaziabad, Farrukhabad and Etawah with the index value lie between 90.41 and 120.64. Medium productivity area accounts for 37.50 per cent of the total area under oilseeds in the region.

A comparatively large area of low productivity is seen on northeastern part of the study area together with a small patch in the central part covering the districts of Mainpuri, Shahjahanpur, Budaun and Moradabad. These districts where the index value is less than 90.41 accounts for 21.14 per cent of the total area under oilseeds in Western Uttar Pradesh.

7.2.5 Productivity Regions (1990-91): Composit Index

After calculating the composit index of agricultural productivity for each group of crops, the overall picture of agricultural productivity is presented in Figure 43 and index values of each districts are given in Table-XXVIII.

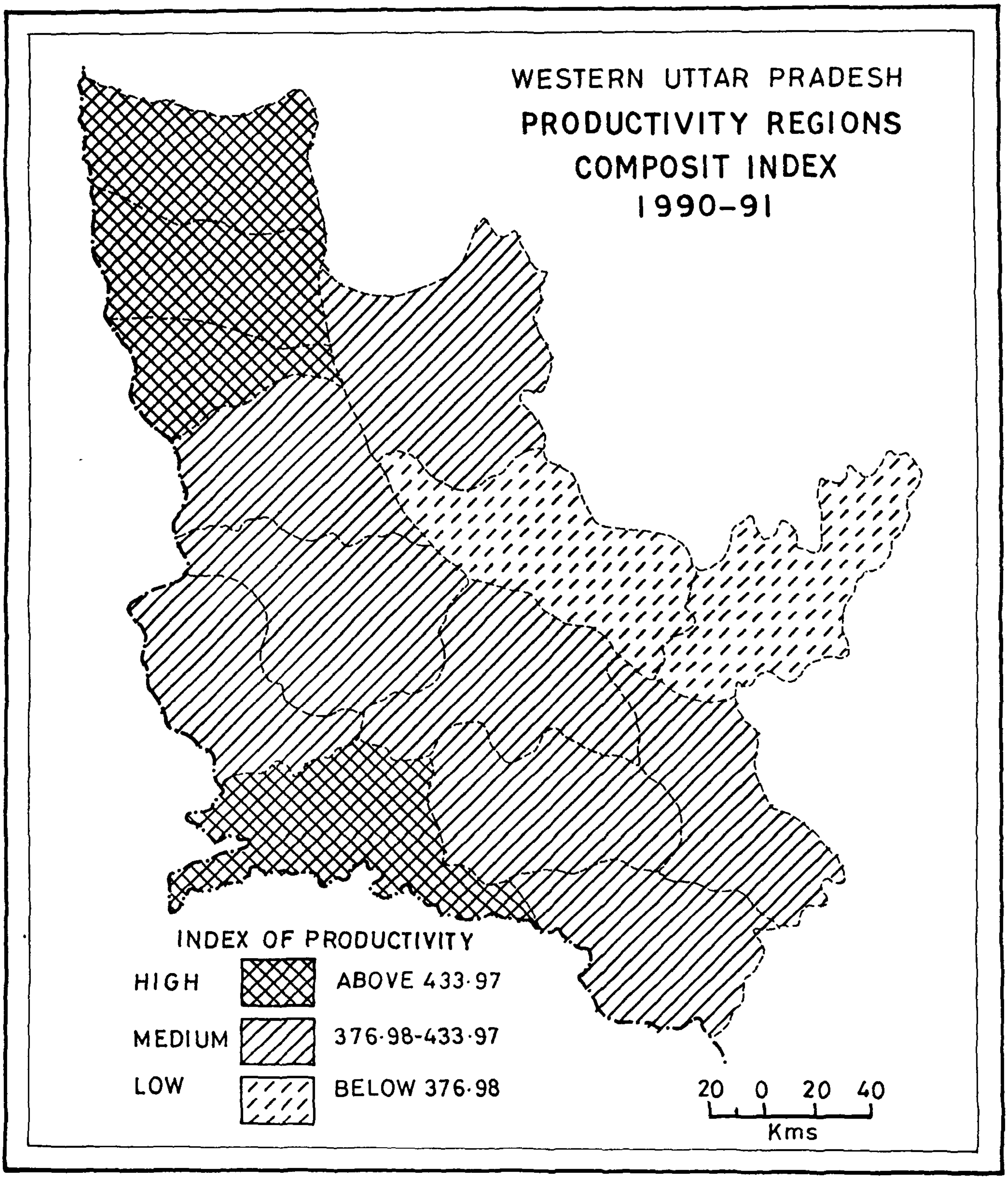
WESTERN UTTAR PRADESH
PRODUCTIVITY REGIONS
COMPOSIT INDEX
1990-91
INDEX OF PRODUCTIVITY
HIGH
ABOVE 433·97
MEDIUM
376·98-433·97
LOW
BELOW 376·98
20 0 20 40
Kms

FIG.43

About thirty one per cent of the total cropped area of Western Uttar Pradesh has high productivity of agriculture. This area is comprised of five districts, namely, Agra, Bulandshahr, Muzaffarnagar, Merrut and Ghaziabad making a belt which stretches in the south of the study area.

There is a large area of medium productivity which lies on the western, central and eastern parts of the region. A small patch of medium productivity is also seen on the northeastern part covering the districts of Mainpuri, Mathura, Etah, Farrukhabad, Aligarh, Etawah and Moradabad. All these districts together commanded half of the total cropped area of the study region with the index value below between 376.98 to 433.97.

The area having low productivity lies in the districts of Shahjahanpur and Budaun. The low productivity area accounts for 16.11 per cent of the total cropped area of the study region with index value below 376.98.

7.3 Agricultural Productivity: Pattern of change between 1950-51 to 1990-91

The change in agricultural productivity in Western Uttar Pradesh from 1950-51 to 1990-91 are given in Table-XXIX. This Table incorporates the changes in acreage and their percentages under different crops. It is clear from the Table-XXVIII that during the last four decades the high productivity area under cereal crops increased by 1,765,512 hectares and medium productivity area increased by 664,127 hectares. On the other hand the low productivity area under cereals witnessed a decline of 962,820 hectares. The increase in terms of percentage was 496.03 per cent for high productivity area, 44.01 per cent for medium productivity while the decline in productivity area was 71.49 per cent under low productivity. It clearly indicates the impact of various institutional and technological factors operating in the region which helped in converting low productivity areas of 1950-51 into high and medium productivity areas in 1990-91.

Table-XXIX

Areal change of agricultural productivity in Western Uttar Pradesh from 1950-51 to 1990-91

(Figures for area show hectares)

	CEREALS		PULSES		CASH CROPS		OILSEEDS		OVERALL AGRICULTURAL PRODUCTIVITY	
CATEGORY	Change in Area	Percentage change	Change in Area	Percentage change	Change in Area	Percentage change	Change in Area	Percentage change	Change in Area	Percentage change
High	+1765512	496 03	-462659	-85 31	+46305	16 51	+161184	1749 71	+884870	79 52
Medium	+664127	44 01	+50147	69 31	+403926	452 64	+177304	1027 19	+1877254	126 40
Low	-962820	-71 49	-391390	-70 50	+98774	145 00	+30097	52 77	-1221537	-53 00

As compared to cereals, the study of pulses reveals a different story. The high productivity area of pulses has decreased with a loss of 46,259 hectares accounts for 85.31 per cent. The medium productivity area recover by 50,147 hectares or 69.31 per cent of the total area under pulses. The low productivity area recorded an increase in only one district, while on the otherhand it decreased by 391,390 hectares accounting to 70.50 per cent of the total area under pulses. Thus the area under high and low productivity of pulses on the whole suffered a loss. Whereas there was some increase in the medium productivity area.

The downfall trend in the productivity of pulses indicates that it has not been influenced by the modern technology. The use of indigenous seeds and non-use of chemical fertilizers and the spread of many insects and pests have reduced the production of pulses in the region. It has been observed in Western Uttar Pradesh that the area earlier devoted to pulses cultivation is now gradually giving way to other crops. The improved pulses technology in the region is almost nil and the farmers grow pulses as a mixed crop. The production of pulses can be increased by making its production profitable through the development of high yielding varities of seeds and better farm management. It will help in increasing the area under pulses and the farmers will invest more capital if he is sure of getting handsome returns.

The position of cash crops has varied between 1950-51 and 1990-91. The area of high productivity of cash crops decreased in one district but in others it has gained 46,305 hectares or 16.51 per cent of the total cash crops area. Medium productivity area of cash crops has increased in one district wherein 403,926 hectares or 452.64 per cent of cash crops area have been added. Likewise 98,774 hectared have been added to low productivity cash crops area.

Oilseeds are the last group of crops grown in Western Uttar Pradesh and have increased their area under high and medium productivity. High productivity oilseeds area between 1950-51 and 1990-91 has increased by 161,184 hectares which accounts for 1749.71 per cent of the area under oilseeds. The medium productivity area has a tremendous increase of 177,304 hectares accounting to 1027.19 per cent from the base year 1950-51. The low productivity area of oilseeds has decreased in some districts but on the whole it has recorded an increase of 52.77 per cent from the base year 1950-51.

The productivity regions based on composit index of agricultural productivity indicates that high productivity area in Western Uttar Pradesh has increased by 884,870 hectares accounting for 79.52 per cent of the total area under high productivity. Medium productivity area has recorded high gain of 1,877,254 hectares or 126.40 per cent of the area under the same productivity region. The low productivity area however has decreased by 1,221,537 hectares, the decrease being 53.00 per cent of the area under low productivity.

It can be concluded that the areal extent of high and medium productivity has recorded an increase whereas that of low productivity has witnessed decrease during 1950-51 and 1990-91. A little more than half of the low productivity area of

1950-51 has improved its position and is classified as medium and high productivity area in 1990-91.

CHAPTER VIII

MODERN TECHNOLOY AND AGRICULTURAL DEVELOPMENT

The impact of technological and institutional factors on agricultural development in western Uttar Pradesh has been assessed by firstly determining the inter relationship between independent variables during the period 1970-71 to 1990-91 and secondly, by determining the precise role of various indicators of agricultural development through factor analysis. The variables considered for this purpose are shown in Table XXX.

8.0 Inter relationship among independent variables: [1970-71]

For determining the inter-relationship among the independent variables, each variable has once been considered as dependent variable and then its relationship with other variables is correlated. The results thus obtained are tabulated in Table XXXI.

The correlation of tubewells and pumping sets with other variables indicates that it is highly correlated positively with high yielding varieties of seeds (0.920) followed by tractor power (0.877), irrigation intensity (0.847) and fertilizer consumption (0.768). It is moderately correlated with seed drills (0.693), rural electrification (0.688) and literacy rate (0.477). The highest negative correlation of this variable is shown by agricultural workers & cultivators (-0.527) closely followed by iron plough (-0.504) and size of land holdings (-0.494).

Table XXX

Variables selected for calculating agricultural development

Variables	Definition
X_1	Tube wells and pumping sets per 10,000 hectares of gross cropped area
X_2	Seed drills per 10,000 hectares of gross cropped area
X_3	Iron plough per 10,000 hectares of gross cropped area
X_4	Tractor power per 10,000 hectares of gross cropped area
X_5	Fertilizer consumption in Kg. per hectare
X_6	Percentage of area under high yielding varieties of seeds from total cropped area
X_7	Irrigation intensity as percentage from gross irrigated area
X_8	Rural electrification as percentage to the total village
X_9	Cooperative Banks per lakh of population
X_{10}	Literacy rate as percentage to the total population
X_{11}	Size of land holdings in hectares
X_{12}	Agricultural workers & cultivators as percentage from the total population

When seed drills is taken as a dependent variable its correlation with other independent variables is strong with tractor power (0.737), high yielding varieties of seeds (0.648), irrigation intensity (0.640) and fertilizer consumption (0.584).

The assessment of iron plough as a dependent variable (Y), reveals highest positive correlation with the size of land holdings (0.584) and agricultural workers & cultivators (0.463). The highest negative correlation of this variable is recorded in order by rural electrification (-0.545), high yielding varieties of seeds (-0.437), literacy rate (-0.433) fertilizer consumption (-0.432) and irrigation intensity (-0.417).

Taking tractor power as a dependent variable (Y), its correlation with independent variables are strong with high yielding varieties of seeds (0.917), irrigation intensity (0.907), fertilizer consumption (0.907), tubewells and pumping sets (0.877), rural electrification (0.753), seed drills (0.737) and literacy rate (0.551). The highest negative correlation is seen with agricultural workers and cultivators (-0.597) together with size of land holding (-0.510).

When fertilizer consumption is treated as a dependent variable (y), its correlation with independent variables is very high with irrigation intensity (0.923), tractor power (0.907), rural electrification (0.868) and high yielding varieties of seeds (0.860). It is moderately correlated

Table XXXI

Matrix of correlation coefficients for the independent variables 1970-71

X_1	1 00000											
X_2	0 69344	1 00000										
X_3	-0 50436	0 05805	1 00000									
X_4	0 87771	0 73784	-0 36577	1 00000								
X_5	0 76837	0 58423	-0 43222	0 90705	1 00000							
X_6	0 92036	0 64840	-0 43799	0 91728	0 86064	1 00000						
X_7	0 84756	0 64033	-0 41712	0 90759	0.92301	0.92663	1 00000					
X_8	0 68885	0 35717	-0 54509	0 75319	0 86803	0 78603	0 90490	1 00000				
X_9	0 16652	0 08008	0 13905	0 28273	0 27581	0 17686	0 30010	0 32977	1 00000			
X_{10}	0 47746	0 28410	-0 43366	0 55190	0 48472	0 48407	0 54795	0 68822	0 33476	1 00000		
X_{11}	-0 49474	-0 08071	0 58457	-0 51004	-0 47564	-0 52912	-0 52117	-0 66158	-0 10929	-0 78635	1 00000	
X_{12}	-0 52795	-0 37132	0 46343	-0 59781	-0 56237	-0 43698	-0 50829	-0 61627	-0 25953	-0 89442	0 71595	1 00000

with tube wells and pumping sets (0.768), seed drills (0.584) and literacy rate (0.487). The highest negative correlation of the same variable is shown by agricultural workers & cultivators (-0.562) and size of land holdings (-0.475) and iron plough (-0.437).

The correlation of high yielding varieties of seeds with other variables indicates its relation with irrigation intensity (0.926), tubewells and pumping sets (0.920), tractor power (0.917) and fertilizer consumption (0.860). It is moderately correlated with rural electrification (0.786), seed drills (0.648) and literacy rate (0.484). Its highest negative correlation is shown by size of land holdings (-0.529), agricultural workers & cultivators (-0.439) and iron plough (-0.437).

Irrigation intensity as a dependent variable (Y) is highly correlated with high yielding varieties of seeds (0.926), fertilizer consumption (0.923), tractor power (0.907), rural electrification (0.904), tubewells and pumping sets (0.847) and seed drills (0.640). The variables which are negatively correlated with irrigation intensity are literacy rate (-0.547), agricultural workers & cultivators (-0.508) and iron plough (-0.417).

The correlation of rural electrification with other variables indicates that it is highly correlated with irrigation intensity (0.904) followed in order by fertilizer consumption (0.868), high yielding varieties of seeds (0.786), literacy rate (0.688), tubewells & pumping sets (0.688) and tractor power (0.753). The highest negative correlation is recorded by agricultural workers & cultivators (-0.616), size of land holding (-0.661) and iron plough (-0.545).

The literacy rate as a dependent variable (Y) is correlated strongly with rural electrification (0.688), tractor power (0.551), irrigation intensity (0.547), fertilizer consumption (0.484), high yielding varieties of seeds (0.484) and tubewells & pumping sets (0.477). The highest negative correlation with literacy rate is shown by agricultural workers & cultivators (-0.894), size of land holdings (-0.786) and iron plough (-0.433).

Considering size of land holdings as a dependent variable (Y), its correlation with independent variables is strongly positive with agricultural workers & cultivators (0.715) and iron plough (0.584). Its highest negative correlation is shown by literacy rate (-0.786) followed by rural electrification (-0.661), high yielding varieties of seeds (-0.529), irrigation intensity (-0.521), tractor power (-0.510), tubewells & pumping sets (-0.494) and fertilizer consumption (-0.475).

Lastly, the correlation of agricultural workers & cultivators when considered as a dependent variable (Y) with other independent variables indicates that it is positively correlated with size of land holdings (0.715) and iron plough (0.463). The variables which are negatively correlated with it are literacy rate (-0.894), rural electrification (-0.616), tractor power (-0.597), fertilizer consumption (-0.562), tubewells & pumping sets (-0.527), irrigation intensity (-0.508) and high yielding varieties of seeds (-0.436).

8.1 Inter relationship among independent variables: (1990-91)

The inter relationship among the independent variables for the year 1990-91 are shown in Table-XXXII. The Table reveals that the correlation of tubewells & pumping sets *with other independent variables is highly positive with* fertilizer consumption (0.907) followed by irrigation intensity (0.872), tractor power (0.864) and high yielding varieties of seeds (0.802). Further, it is moderately correlated with iron plough (0.765), literacy rate (0.743) and rural electrification (0.727). Three variables which recorded moderately negative relationship with tube-wells & pumping sets are seed drills (-0.583), size of land holdings (-0.433) and agricultural workers & cultivators (-0.408).

Seed drills as a dependent variable (Y) are positively correlated with other independent variables like size of land holdings (0.498) and agricultural workers & cultivators (0.487). There are four variables namely high yeilding varieties of seeds, tubewells & pumping sets, irrigation intensity and

Table XXXII

Matrix of correlation coefficients for the independent variables 1990-91

X_1	1 00000											
X_2	-0 58338	1 00000										
X_3	0 76503	-0 35827	1 00000									
X_4	0 86461	-0 36815	0 79141	1 00000								
X_5	0 90735	-0 34210	0 70570	0 94084	1 00000							
X_6	0 80250	-0 59488	0 54419	0 87139	0 81056	1 00000						
X_7	0 87297	-0 46536	0 67152	0 88917	0 94020	0 82449	1 00000					
X_8	0 72783	-0 43873	0 65957	0 80382	0 75916	0 82379	0 77051	1 00000				
X_9	-0 00615	-0 21200	-0 28480	-0 25231	-0 23909	-0 08680	-0 35356	-0 21570	1 00000			
X_{10}	0 74370	-0 45497	0 66775	0 77382	0 70412	0 79940	0 71639	0 94902	-0 11283	1 00000		
X_{11}	-0 43324	0 49869	-0 45659	-0 37068	-0 31217	-0 40156	-0 34001	-0 67855	0 15454	-0 70848	1 00000	
X_{12}	-0 40882	0 48763	-0 42248	-0 50524	-0 30619	-0 56696	0 27660	-0 61602	-0 25701	-0 65016	0 53922	1 00000

literacy rate which recorded high negative relationship with seed drills. The highest negative relationship is shown by high yielding varieties of seeds (-0.594) followed by tubewells & pumping sets (-0.583), irrigation intensity (-0.465) and literacy rate (-0.454).

Assuming iron plough as a dependent variable (Y) its correlation with other independent variables is found positively high with tractor power (0.791), tubewells & pumping sets (0.765), fertilizer consumption (0.707), irrigation intensity (0.671), literacy rate (0.667), rural electrification (0.659) and high yielding varieties of seeds (0.544). The two variables that recorded negative relationship with iron plough are size of land holdings (-0.456) and agricultural workers & cultivators (-0.422).

The correlation of tractor power with other independent variables is high with fertilizer consumption (0.940), irrigation intensity (0.889), high yielding varieties of seeds (0.871), tubewells & pumping sets (0.864), rural electrification (0.803), iron plough (0.791) and literacy rate (0.773). There is only one variable, i.e., agricultural workers & cultivators (-0.505) which represent negative relationship with tractor power.

Fertilizer consumption has high positive correlation with irrigation intensity (0.940) followed by tractor power (0.940), tubewells & pumping sets (0.907) and high yielding varieties of seeds (0.810). It is also moderately correlated with rural electrification (0.759), iron plough (0.707) and literacy rate (0.704).

The correlation of high yielding varieties of seeds with other independent variables indicates that it is positively highly correlated with tractor power (0.871), irrigation intensity (0.824), rural electrification (0.823), fertilizer consumption (0.810), tubewells & pumping sets (0.802), iron plough (0.544) and literacy rate (0.799). There are three variables which show negative relationship e.g. seed drills (-0.594), agricultural workers & cultivators (-0.566) and size of land holdings (-0.401).

Considering irrigation intensity as a dependenet variable (Y) its correlation with other dependent variables is found positively strong with fertilizer consumption (0.940), tractor power (0.889), tubewells & pumping sets (0.872), high yielding varieties of seeds (0.824), rural electrification (0.770), literacy rate (0.716) and iron plough (0.671). There is only one variable i.e. seed drills (-0.465) which shows negative relationship with irrigation intensity.

The rural electrification has highest positive correlation with literacy rate (0.949), high yielding varieties of seeds (0.823), tractor power (0.803), irrigation intensity (0.770), fertilizer consumption (0.759), tubewells & pumping sets (0.727) and iron plough (0.659). Three other variables namely, size of land holdings (-0.678), agricultural workers & cultivators (-0.616) and seed drills (-0.438) recorded negative relationship wih rural electrification.

The literacy rate is strongly correlated with rural electrification (0.949), high yielding varieties of seeds (0.799), tractor power (0.773), irrigation intensity (0.716), fertilizer consumption (0.704), iron plough (0.667) and tubewells & pumping sets (0.643). The highest negative relationship with literacy rate is shown by size of land holdings (-0.708) followed by agricultural workers & cultivators (-0.650) and seed drills (-0.454).

The correlation of size of land holdings with other independent variables reveals strong link with agricultural workers & cultivators (0.539) and seed drills (0.498). Its highest negative relationship is shown by literacy rate (-0.708) followed by rural electrification (-0.678), iron plough (-0.456), tubewells & pumping sets (-0.433) and high yielding varieties of seeds (-0.401).

Agricultural workers & cultivators have positively strong correlation with the size of land holdings (0.539) and seed drills (0.487). Their highest negative relationship exists with literacy rate (-0.650), rural electrification (-0.616), high yielding varieties of seeds (-0.566), tractor power (-0.505), iron plough (-0.422) and tubewells & pumping sets (-0.408).

8.2 Factor Analysis

Factor analysis is considered to be a sound technique in assessing the role of various factors of agricultural development of a region because by this technique independent variables can adequately be described by smaller set of factors. The factor analysis attempts to assess the values of regression coefficients where the original variables are regressed on the factors. The coefficients of regression are termed as factor loadings. Factor loadings give a set of new factor loadings if further processed by rotations.

Many authors, like Kaiser (1958)[1], Ahmad (1965)[2], Harmon (1967)[3], Morison (1967)[4] and others have used factor analysis in their studies. In the present analysis the twelve variables which are given in Table-XXX and are considered to be suitable indices of agricultural development are collapsed into each other and are rotated further to form precise and new variables of agricultural development in Western Uttar Pradesh. This analysis is carried out for two separate years, i.e.

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1. **Kaiser, H.F.**, "The Varimox criteria for Analytic Rotation in Factor Analysis", Psychometrika, vol.13. 1958
2. **Ahmad, Q.**, Indian Cities: Characteristics and correlatates, University of Chicago, Research paper no.102. 1965
3. **Harman, H.H.**, Modern Factor Analysis", University of Chicago press, Chicago, 1967
4. **Morrison, D.F.**, Multivariate Statistical Methods, McGraw Hill Book Co., New York, 1967

1970-71 and 1990-91. The correlations have been done through factor analysis package programme on computer VAX-11-system. The values of the twelve variables have been computed for fourteen districts[5] resulting in a 12 x 14 data matrix for the study region.

8.2.1 Factor I: (1970-71)

The analysis of the variables for the year 1970-71 indicates that 75.34 per cent of the total variance is explained by two factors (Table-XXXIII). Factor I expalins 61.10 per cent of the total variance explained . The highest positive loading is shown by high yielding varieties of seeds (0.903) and tractor power (0.897). These variables are closely followed by irrigation intensity (0.879) and tubewells & pumping sets (0.865). These positive relationships of agricultural mechanization have further high loadings with seed drills (0.844), fertlizer consumption (0.840) and rural electrification (0.634).

The positive relationship among these variables of agricultural development is obvious as the use of high yielding varieties and chemical fertilizers need abundant irrigation. Tractor under Indian conditions is used both on the farm and off the farm. Association of tractorization with these variables is

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5. Ghaziabad was formed as an independent district in 1976-77 and therefore, the analysis for this district was carried out for 1976-77 and 1990-91

Table XXXIII
Factor Structure of agricultural development in Western Uttar Pradesh through rotated factor Matrix, 1970-71

Variables	Factor loadings		
	F_1	F_2	h^2
X_1	0.865	-0.342	0.782
X_2	0.844	0.118	0.750
X_3	-0.206	0.712	0.811
X_4	0.897	-0.348	0.941
X_5	0.840	-0.385	0.862
X_6	0.903	-0.330	0.928
X_7	0.879	-0.385	0.932
X_8	0.634	-0.642	0.827
X_9	0.137	-0.177	0.816
X_{10}	0.248	-0.849	0.873
X_{11}	-0.211	0.886	0.832
X_{12}	-0.298	0.796	0.778
Variance explained in percent	61.10	14.24	
Comulative percentage of Variance explained	61.10	75.34	

h^2 = communalities

well understood in the agricultural mechanization of the region. Electrification has an important role in the agricultural development of the region. Because farm machinary run by electricity is cheaper than that run on fuel energy. Seed drills are found in great numbers in areas where high yielding varieties of seeds are more in practice.

Factor II: It accounts for 14.24 per cent of the total variance and is strongly loaded on about twenty eight per cent of the variables. The rotated factor shows highest positive loading by size of land holdings (0.886) which is closely associated with agricultural workers & cultivators (0.796) and iron plough (0.712). It is an obvious fact that in regions where size of land holdings small and their number is large, the use of agricultural workers and iron plough becomes essential.

The variables which have negative loadings are rural electrification (-0.796) and literacy rate (-0.849).

8.2.2. Factor I (1990-91)

The values of twelve variables during 1990-91 have been computed for fourteen districts resulting in a 12 x 14 data matrix for the study region. The data matrix collapsed into each other leads to three factors of agricultural development. It shows that in all 84.97 per cent of the total variance is explained by these three factors given in Table-XXXIV. Factor I accounts for 62.53 per cent of the total variance. The positive

Table XXXIV

Factor Structure of agricultural development in Western Uttar Pradesh through rotated factor Matrix, 1990-91

Variables	Factor loadings			
	F_1	F_2	F_3	h^2
X_1	0.901	0.187	-0.261	0.916
X_2	-0.381	-0.518	0.455	0.622
X_3	0.700	-0.165	-0.387	0.668
X_4	0.921	-0.051	-0.287	0.935
X_5	0.965	-0.063	-0.137	0.955
X_6	0.822	0.189	-0.372	0.851
X_7	0.942	-0.113	-0.182	0.735
X_8	0.673	-0.074	-0.664	0.900
X_9	-0.215	0.915	0.061	0.888
X_{10}	0.630	0.006	-0.703	0.892
X_{11}	-0.151	0.093	0.916	0.871
X_{12}	-0.239	-0.405	0.732	0.758
Variance explained in percent	62.53	13.65	8.79	
Comulative percentage of Variance explained	62.53	76.18	84.97	

h^2 = communalities

sign of variables is associated with the higher development of agriculture and infrastructure. Irrigation, fertilizer, tractorization, tubewells & pumping sets and high yielding varieties of seeds are all loaded high and positively on this factor. While iron plough, rural electrification and literacy rate load moderately on this aspect. The highest positive loading is shown by fertilizer consumption (0.965)which is closely followed by irrigation intensity (0.942), tractorization (0.921), tubewells & pumping sets (0.901) and high yielding varieties of seeds (0.822). These positive relationships of agricultural mechanization have further moderate loadings with iron plough (0.700), literacy rate (0.630) and rural electrification (0.670).

The positive relationship among these variables of agricultural development is because the use of fertilizers and high yielding varieties of seeds requires high doses of irrigation. The irrigation facilities come from tubewells & pumping sets. Mechanization constitutes an increasing ingredient of modern agriculture. Tractorization is the most common form of mechanised agriculture. Use of tractors raises both the yield per hectare and cropping intensity. The agricultural development is closely related with literacy rate of the farmers. It is the basis of creation - dissemination system that triggers technical progress, which is the main component of agriculture and increased productivity of labour.

Factor II: Factor II accounts for 13.65 per cent of the total variance explained and is closely related with the variables of banks, seed drills and agricultural workers & cultivators. The relationship suggest that this is the dimension of institutional development and agricultural intensity. The rotated factors show that the highest positive loading is by banks (0.915). The highest negative loading is shown by seed drills (-0.518) followed by agricultural workers & cultivators (-0.405). Bank establishment are found in areas that are more productive and agriculturally well-off. Majority of the Indian farmers need finance not only for production purposes but also for consumption purposes. The main objective of the co-operative banks is to provide credit and other facilities particularly to the small and marginal farmers so as to develop agriculture.

Factor III: Factor III which accounts for 8.79 per cent of the total variance explained is strongly related to the size of land holdings, agricultural workers & cultivators, seed drills, literacy rate and rural electrification.

The highest positive loading on this factor is registered by size of land holdings (0.916). This is followed by agricultural workers & cultivators (0.732) and seed drills (0.455). The highest negative loading on this factor is shown by literacy rate (-0.703) followed by rural electrification (-0.664).

8.3. Factor Analysis of Productivity Regions: (1990-91)

After analysing the factors on a macro level in the region as a whole, the author further analysed it on a micro level in the three major agricultural productivity regions of Western Uttar Pradesh for the year 1990-91. The rotated factor matrix for each of the three regions recorded two factors but the per cent of the commulative variance explained are dissimilar.

8.3.1 High Productivity Region

It is seen from Table-XXXV that the total variance of high productivity region is explained by 79.23 per cent.

Factor I: In this productivity region, factor I recorded 58.90 per cent of the total variance explained and consists of the variables of tubewells & pumping sets, tractor power, fertilizer consumption, area under high yielding varieties of seeds, irrigation intensity, rural electrification, cooperative banks and literacy rate.

The highest positive loading is shown by tubewells & pumping sets (0.970), literacy rate (0.941), area under high yielding varieties of seeds (0.936), rural electrification (0.907) and irrigation intensity (0.838). These positive relationships of agricultural development have further positive high loadings with tractor power (0.772), cooperative banks

Table XXXV

Factor Structure of agricultural development in Western Uttar Pradesh through rotated factor Matrix: high productivity region, 1990-91

Variables	Factor loadings F_1	Factor loadings F_2
X_1	0.97009	-0.20328
X_2	-0.98009	0.15346
X_3	0.39595	-0.19686
X_4	0.77263	-0.35076
X_5	0.71754	-0.63612
X_6	0.93686	0.01695
X_7	0.83816	-0.11282
X_8	0.90751	0.06315
X_9	0.72597	-0.39468
X_{10}	0.94150	0.13486
X_{11}	0.24778	-0.85082
X_{12}	-0.14141	-0.94548
Variance explained in per cent	58.90	20.33
Comulative variance explained in per cent	58.90	79.23

(0.725) and fertilizer consumption (0.717). There is only one variable namely seed drills (-0.980) which recorded high negative loading.

Factor II:

Factor II, which explained 20.33 per cent of the total variance explained has high negative loadings on fertilizer consumption (-0.636), size of land holdings (-0.850) and agricultural workers & cultivators (-0.245).

8.3.2. Medium Productivity Region

There are two factors which explain 75.02 per cent of variance recorded under medium productivity regions of Western Uttar Pradesh as given in Table-XXXVI.

Factor I:

Factor I accounts for 48.33 per cent of the total variance explained and is consists with the variables of tube-wells & pumping sets, fertilizer consumption, area under high yielding varieties of seeds, irrigation intensity, iron plough, tractor power, rural electrification, literacy rate, size of land holdings and agricultural workers & cultivators.

The highest positive loading is shown by tube-well & pumping sets (0.934) which is followed by area under high yielding varieties of seeds (0.796), irrigation intensity (0.687) and fertilizer consumption (0.682).

Table XXXVI

Factor Structure of agricultural development in Western Uttar Pradesh through rotated factor Matrix: medium productivity region, 1990-91

Variables	Factor loadings	
	F_1	F_2
X_1	0.93479	-0.01251
X_2	0.20240	0.76852
X_3	-0.69493	-0.88392
X_4	-0.59210	0.90915
X_5	0.68216	-0.40842
X_6	0.79682	-0.28750
X_7	-0.68728	-0.30864
X_8	-0.85524	-0.31565
X_9	0.44172	-0.61191
X_{10}	-0.68915	-0.36355
X_{11}	-0.61721	0.11913
X_{12}	-0.83478	0.19253
Variance explained in per cent	48.33	26.68
Comulative variance explained in per cent	48.33	75.02

The highest negative loading is recorded by rural electrification (-0.855) and agricultural workers & cultivators (-0.834). These relationships further have moderate negative loading with the variables of iron plough (-0.694), literacy rate (-0.689), size of land holdings (-0.617) and tractor power (-0.592).

Factor II:

Factor II which explained 26.68 per cent of the total variance explained has high positive loadings on seed drills (0.768) and tractor power (0.909). In the same factor the highest negative loading is shown by iron plough (-0.883) followed by co-operative banks (-0.611).

8.3.3. Low Productivity Region

There are two factors which explain 75.40 per cent of variance recorded under low productivity region of the study area as tabulated in Table-XXXVII.

Factor I:

Factor I which explains 30.15 per cent is consists with the variables of tube-wells & pumping sets, area under high yielding varieties of seeds and irrigation intensity. The highest positive loading in shown by area under high yielding varieties of seeds (0.883) which is followed by tubewells & pumping sets (0.867) and irrigation intensity (0.796). In the same factor, there is only one variable which recorded high negative loading, i.e. literacy rate (-0.837).

Table XXXVII

Factor Structure of agricultural development in Western Uttar Pradesh through rotated factor Matrix: low productivity region, 1990-91

Variables	Factor loadings F_1	Factor loadings F_2
X_1	0.86737	-0.40482
X_2	0.02844	0.77531
X_3	0.39979	-0.81736
X_4	-0.17806	-0.74810
X_5	-0.47262	0.80747
X_6	0.88300	0.29760
X_7	0.79651	-0.47621
X_8	-0.32923	-0.86570
X_9	0.20336	-0.71200
X_{10}	-0.83772	-0.11874
X_{11}	-0.39616	0.71168
X_{12}	0.16713	-0.83270
Variance explained in per cent	30.15	45.25
Comulative variance explained in per cent	30.15	75.40

Factor II:

Factor II which explained 45.25 per cent of the total variance explained consists of a large set of variables. These variables are seed drills, fertilizer consumption, size of land holdings, agricultural workers & cultivators, iron plough, tractor power, rural electrification and co-operative banks.

The highest positive loading is shown by agricultural workers & cultivators (0.832) and fertilizer consumption (0.807). These positive relationships of agricultural development have further moderate loadings on seed drills (0.775) and size of land holdings (0.711).

The highest negative loading of the same factor is shown by rural electrification (-0.865) which is followed by iron plough (-0.817), tractor power (-0.748) and cooperative banks (-0.712).

After analysing the factor matrix on micro level of three different productivity regions of Western Uttar Pradesh for the year 1990-91, the author arranged a large number of variables into significant combinations for the year 1990-91 as mentioned in Table-XXXVIII.

It can be seen from the Table-XXXVIII that in the high productivity region the combination I gives the most interesting results. This combination comprises of tubewells and pumping sets, tractor power, fertilizer consumption, area under

Table XXXVIII

Productivity: regionwise combination of variables in Western Uttar Pradesh 1990-91

Productivity	Combination	Variables selected in combination	Factor loadings F_1	F_2	F_3
High	I	X_1	0.970	-	-
		X_4	0.772	-	-
		X_5	0.717	-	-
		X_6	0.936	-	-
		X_7	0.838	-	-
		X_8	0.907	-	-
		X_9	0.725	-	-
		X_{10}	0.941	-	-
Medium	II	X_1	0.934	-	-
		X_5	0.682	-	-
		X_6	0.796	-	-
		X_7	0.687	-	-
	III	X_2	-	0.768	-
		X_4	-	0.909	-
Low	IV	X_1	0.867	-	-
		X_6	0.883	-	-
		X_7	0.796	-	-
	V	X_2	-	0.775	-
		X_5	-	0.807	-
		X_{11}	-	0.711	-
		X_{12}	-	0.832	-
	VI	X_1	0.901	-	-
		X_3	0.700	-	-
		X_4	0.921	-	-
		X_6	0.822	-	-
		X_7	0.942	-	-
		X_8	0.673	-	-
		X_{10}	0.630	-	-
	VII	X_9	-	0.915	-
	VIII	X_2	-	-	0.455
		X_{11}	-	-	0.916
		X_{12}	-	-	0.732

high yielding varieties of seeds, irrigation intensity, rural electrification, cooperative banks and finally literacy rate.

In the medium productivity region, the combination II is ideally suited for agricultural development combined with tube-wells and pumping sets, fertilizer consumption, area under high yielding varieties of seeds and irrigation intensity. The combination III is comprising of the variables of seed drills and tractor power.

In the low productivity region, the combination IV is well suited for agricultural development and is comprised of the variables of tube-wells and pumping sets, area under high yielding varieties of seeds and irrigation intensity. The combination V is combined with the variables of seed drills, fertilizer consumption, size of land holdings and agricultural workers & cultivators.

In Western Uttar Pradesh as a whole, the combination VI is comprising with the variables of tube-wells and pumping sets, iron plough, tractor power, fertilizer consumption, area under high yielding varieties of seeds, irrigation intensity, rural electrification and literacy rate.

The combination VIi is combined with the variables of cooperative banks. The combination VIII is comprising with the variables of seed drills, size of land holdings and agricultural workers & cultivators.

The above description indicates that the factor analysis for Western Uttar Pradesh as a whole is less significant than the analysis is performed for three agricultural productivity regions of this region. The results further substantiate the regional sensitivity of packages of agricultural development in the regions but this does not mean that these packages will not have similar effects in the regions, instead it reveals the causes of variations in regional development of agriculture.

CHAPTER IX

LEVELS OF AGRICULTURAL DEVELOPMENT AND TECHNOLOGY: A CORRELATION

The change in the magnitude of technological variables and their influence on agricultural development in Western Uttar Pradesh makes an important aspect of the study. It *can be assessed firstly by analysinq the change* in cultivated area in twenty years i.e., from 1970-71 to 1990-91 and correlating it with change in technological variates. Secondly the change in the agricultural production may be explained in terms of how it is influenced by the change in technological variables selected. And lastly, the changing pattern of agricultural productivity may be discussed and correlated with the change in variables selected to explain their influence on agricultural productivity of the study region.

9.0 The districtwise distribution pattern of the changed cultivated area in hectare from 1970-71 to 1990-81 have been grouped into four grades of above -100,000 hectares, -100,000 to 0 hectares, 0 to +100,000 hectares and above +100,000. Fig. 44 shows that above thirty five per cent of the total districts lie at negative side of the scale meaning thereby that these districts have decreased their area in the final year i.e, in 1990-91. About fifty per cent of the area incrased in the grade of 0 to +100,000 hectares and about fourteen per cent of the area increased in the grade lying above +100,000 hectares.

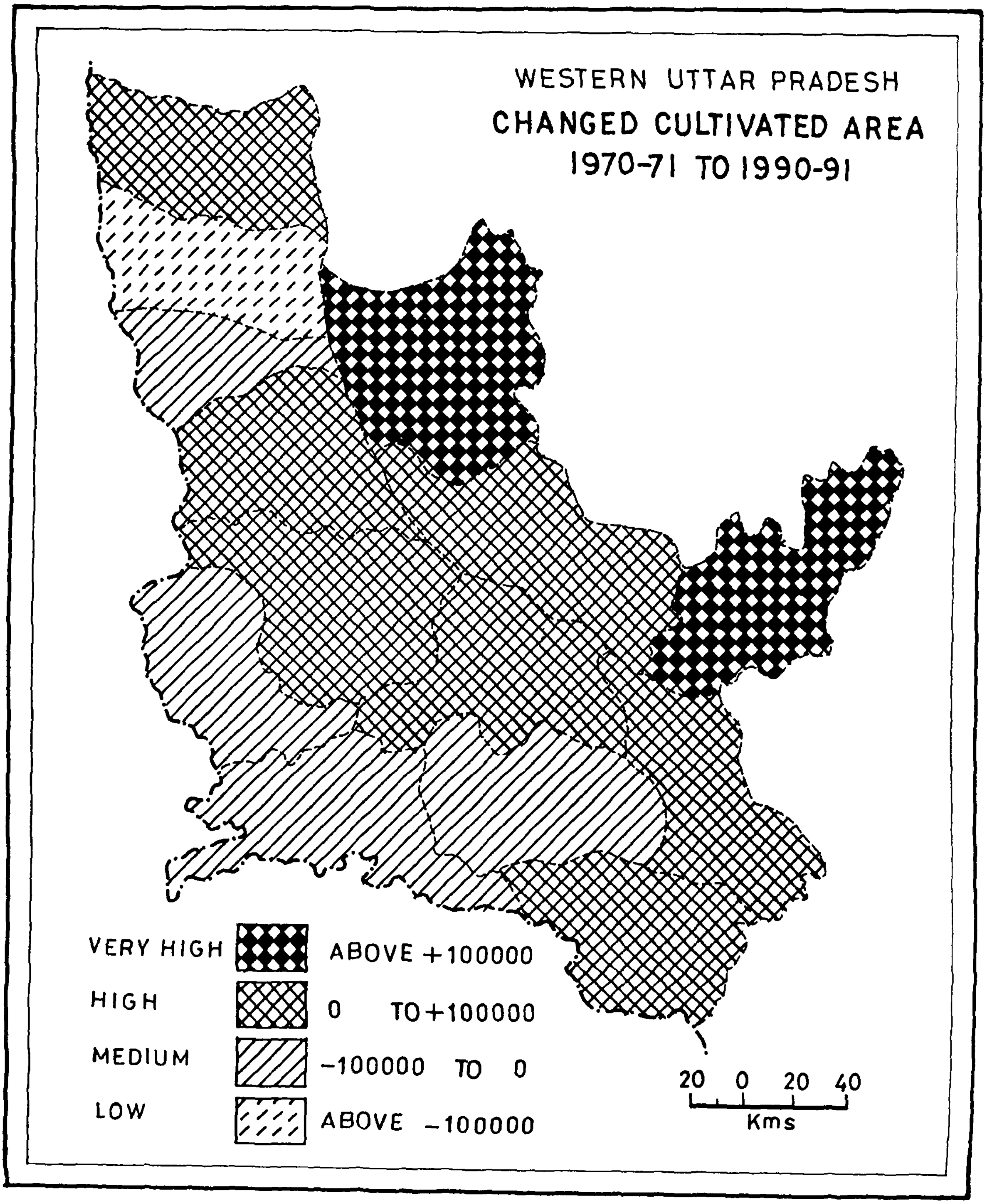
WESTERN UTTAR PRADESH
CHANGED CULTIVATED AREA
1970-71 TO 1990-91
VERY HIGH
ABOVE +100000
HIGH
0 TO +100000
MEDIUM
-100000 TO 0
LOW
ABOVE -100000
20 0 20 40
Kms

FIG.44

There is only one district namely, Meerut which lies in the grade of -100,000 and above. The districts which lie between the grade of -100,000 to 0 are Ghaziabad, Mathura, Agra and Mainpuri. These districts except Ghaziabad form a significant region in the southeastern part of the study region. These districts altogether account for about twenty eight per cent of the total districts of the region. It means that twenty eight per cent of the districts have decreased their area in the final year in 1990-91.

There are seven districts which come under the grade of 0 to +100,000. It means that about fifty per cent of the total districts have increased in areal extent in 1990-91. These districts lie in the northern and south-central parts of the region. The districts which have increased their area in the last year are Muzaffarnagar (62,829 hectares), Bulandshahr (54,098 hectares), Aligarh (49,351 hectares), Etah (57,662 hectares), Budaun (57,995 hectares), Farrukhabad (17,425 hectares) and Etawah (44,684 hectares).

The districts which have increased the area under cultivation and have been put under the highest positive growth rate +100,000 and above are Shahjahanpur and Moradabad. These districts account for about fourteen per cent of the total districts of the region and lie in the eastern part of the study region.

The study reveals that the development in cultivated area in Western Uttar Pradesh is only due to the result of changes in technological factors of agricultural development. The decrease in cultivated area in some districts is due to the decrease in areal extent of some crops like pulses, Jwar and bajra and in some cases oilseeds. The change in cultivated area is influnced by the change in technological variates, it is important to correlate the changed cultivated area (Y_1) with other independent variables.

It may be seen from Table XXXIX that almost thirty three per cent of the variables are directly proportional to the changed cultivated area. The size of the land holdings has the high positive correlation of 0.381 with changed cultivated area. The other three variables i.e., area under high yielding varieties of seeds (0.08), irrigation intensity (0.12) and cooperative banks (0.01) have weak positive correlation with changed cultuivated area. The other variables have negative correlation with changed cultivated area.

9.1 The change in agricultural production (Y_2) from 1970-71 to 1990-91 has shown a positive response among all the districts of the Western Uttar Pradesh. The volume of change in agricultural production has been arranged into four grades of aboce 1,000,000 metric tonnes, between 500,000 to 1,000,000 metric tonnes, 100,000 to 500,000 metric tonnes and below 100,000 metric tonnes. (Fig.45)

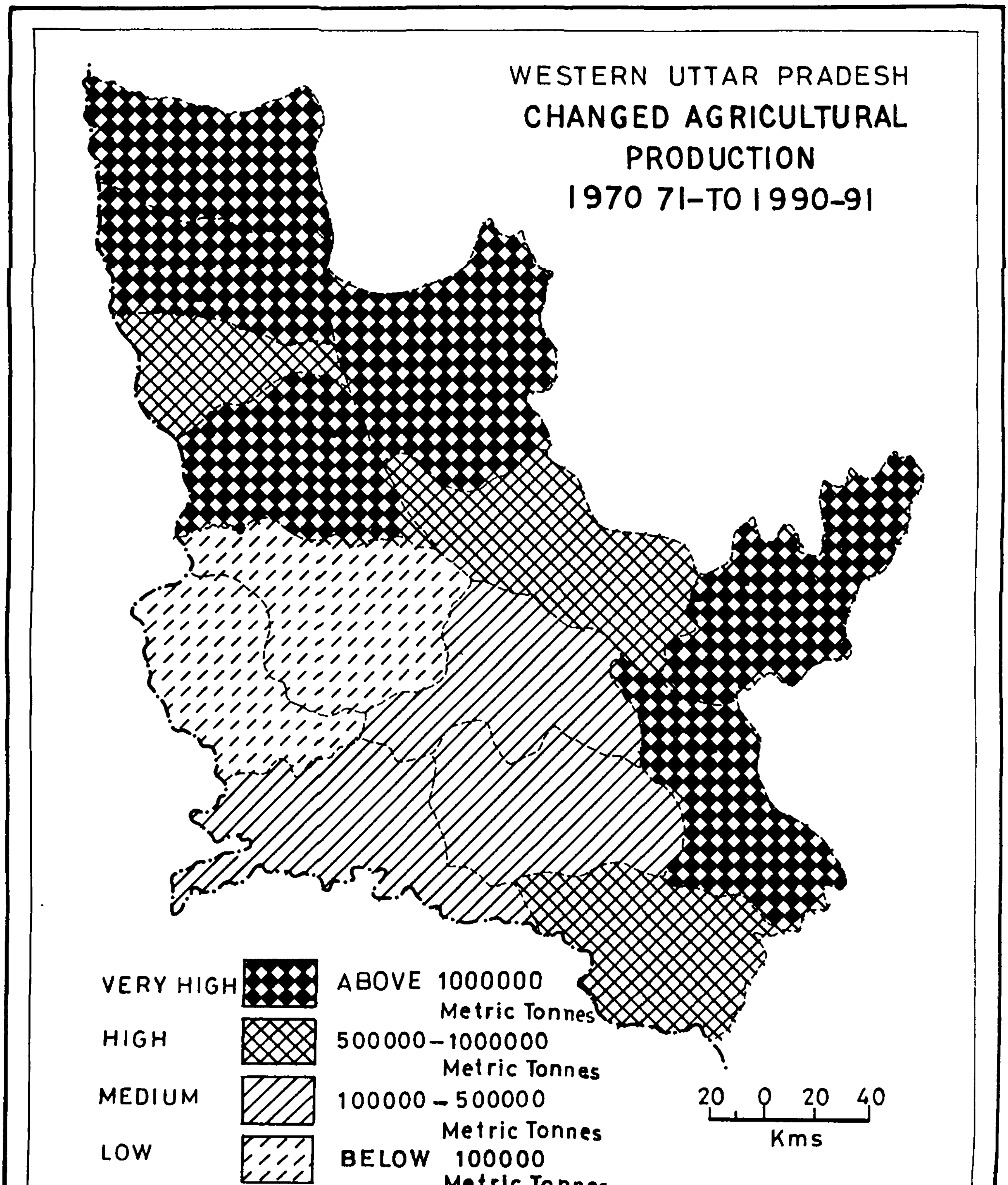
WESTERN UTTAR PRADESH
CHANGED AGRICULTURAL PRODUCTION
1970 71-TO 1990-91
VERY HIGH
ABOVE 1000000 Metric Tonnes
HIGH
500000-1000000 Metric Tonnes
MEDIUM
100000 - 500000 Metric Tonnes
LOW
BELOW 100000 Metric Tonnes
20 0 20 40
Kms

FIG.45

Six districts recorded highest increase in production and in all comprise about forty per cent of the total districts of the study region. The districts which recorded highest increase in production are Muzaffarnagar (7,080,476 metric tonnes), Meerut (2,450,430 metric tonnes), Bulandshahr (1,301,994 metric tonnes), Shahjahanpur (1,335,941 metric tonnes), Moradabad (5,386,831 metric tonnes) and Farrukhabad which recorded a increase of 1,267,715 metric tonnes. These districts separately make two regions of high production. The districts of Muzaffarnagar, Meerut and Bulandshahr lie in the Ganga-Yamuna doab and the districts of Moradabad and Farrukhabad lie in the eastern and north-eastern parts of the study region.

About twenty per cent of the districts fall between the grade of 500,000 to 1,000,000 metric tonnes increase in agricultural production. These districts fail to make any distinct region and are isolated cases. Amongst these districts, Ghaziabad which recorded an increase of 764,613 metric tonnes, Budaun 705,710 metric tonnes and Etawah 560,162 metric tonnes.

There are three districts which lie in the grade of 100,000 to 500,000 metric tonnes of increase in agricultural production. These districts make about twenty per cent of the total districts of the study region and lie in the central part of the Western Uttar Pradesh. The districts which lie in this grade of increase in agricultural production are Agra with an increase of 324,139 metric tonnes, Mainpuri with an increase of 288,010 metric tonnes and Etah with an increase of 481,828 metric tonnes.

There are only two districts namely, Aligarh and Mathura which lie in the grade of less than 100,000 metric tonnes. These distrcits together share about fourteen per cent of the total districts of the region. The districts of Aligarh recorded an increase of 56,796 metric tonnes of agricultural production and the Mathura recorded an increase of 97,758 metric tonnes.

Table XXXIX

Agricultural development and their technological correlates in Western Uttar Pradesh

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
Y_1	-0 04	-0 09	-0 02	-0 09	+0 07	+0 08	-0 12	+0 06	-0 01	+0 01	+0 38	0 48
Y_2	+0 02	+0 01	-0 03	+0 05	+0 04	+0 09	+0 04	+0 07	-0 11	+0 13	+0 03	-0 06
Y_3	+0 41	+0 12	+0 37	+0 49	+0 64	+0 41	+0 59	+0 28	+0 07	+0 08	-0 13	-0 07

Y_1 = Changed cultivated area
Y_2 = Changed agricultural production
Y_3 = Changed agricultural productivity

There existed a very low degree of relationship between the changed agricultural production (Y_2) and independent variables. After examining the relationship it is found that the changed agricultural production is not directly proportional to the changed technological variables. Table-XXXIX reveals that about two third of the variables have positive degree of correlation with changed agricultural production but not upto to the acceptance level. It is seen from the Table XXXVIII that tube wells and pumping sets, seed drills, tractor power, fertilizer consumption, area under high yielding varieties of seeds, irrigation intensity, rural electrification, literacy rate and cooperative banks have positive relationship with changed agricultural production. The remaining variables have negative relationship.

9.2 The districtwise changed agricultural productivity (Y_3) in terms of Yang's Yield Index has been grouped into four grades for the sake of convenience. The changed agricultural productivity in quintals per hectare has a wide range of variation. It is grouped into four grades of over -20 quintals per hectare, 0 to -20 quintals per hectare, 0 to +20 quintals per hectare and finally above +20 quintals per hectare. (Fig. 46)

There is only one district, namely Budaun which decreased its agricultural productivity index more than 20 quintals per hectare. This district lies in the eastern part of the study region and accounts for seven per cent of the total districts of Western Uttar Pradesh.

Districts Shahjahanpur and Etawah accounting for fourteen per cent of the region fall undr the grade of 0 to -20 index. These districts lie in eastern and north eastern parts of the study region.

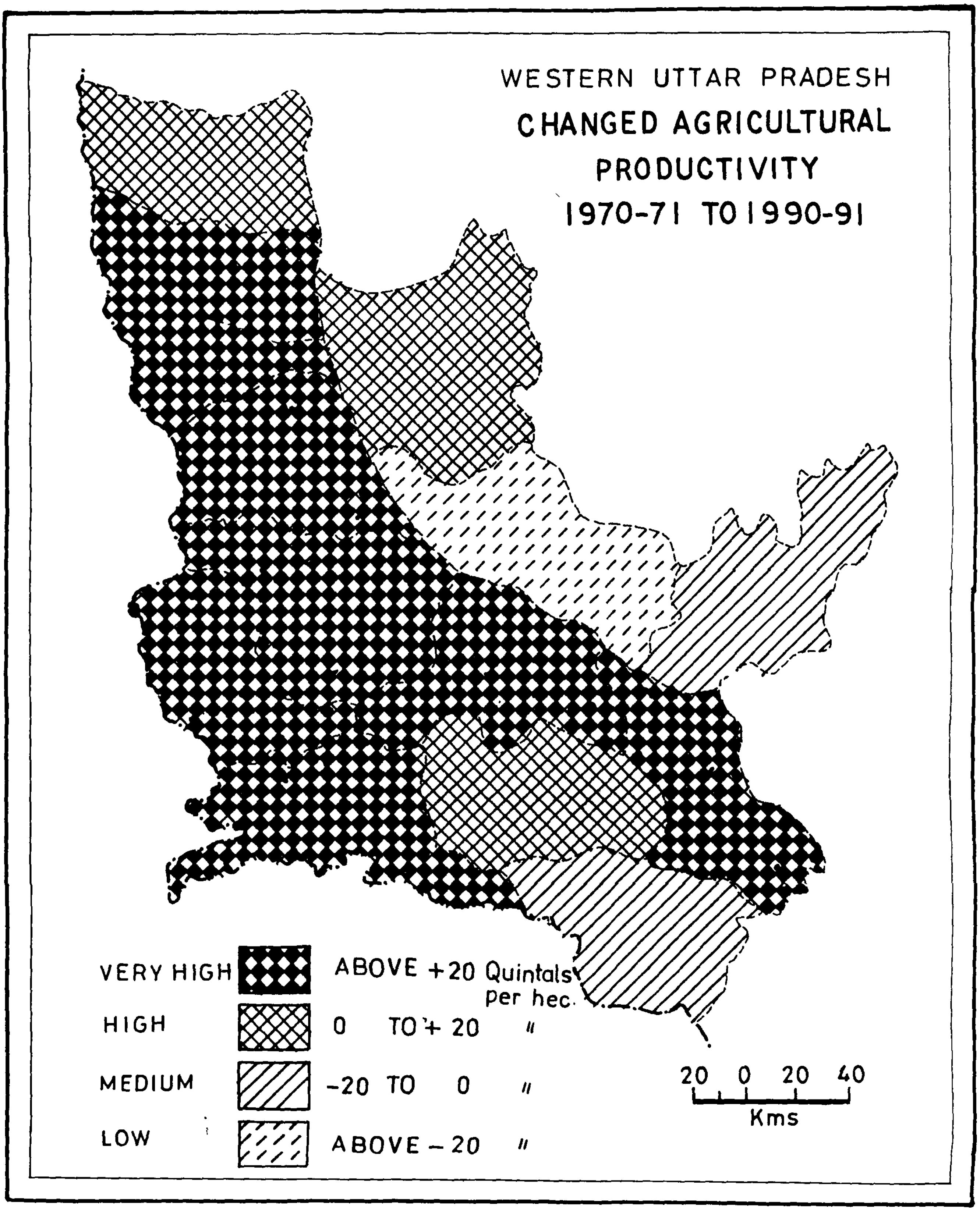
WESTERN UTTAR PRADESH
CHANGED AGRICULTURAL PRODUCTIVITY
1970-71 TO 1990-91
VERY HIGH
ABOVE +20 Quintals per hec.
HIGH
0 TO + 20 "
MEDIUM
-20 TO 0 "
LOW
ABOVE - 20 "
20 0 20 40
Kms

FIG.46

There are three districts which recorded a marginal positive growth of 0 to +20 quintals per hectare in agricultural productivity. These districts are Muzaffarnagar, Mainpuri and Moradabad and make about twenty one per cent of the total districts of Western Uttar Pradesh.

About fifty six per cent of the districts have increased agricultural productivity above 20 index and include Merrut, Ghaziabad, Bulnadshahr, Aligarh, Mathura, Agra, Etah and Farrukhabad. These districts form two distinct regions of Western Uttar Pradesh, one lying in the Ganga-Yamuna doab and comprising the districts of Meerut, Ghaziabad, Bulandshahr and Aligarh and other region lie on the western part of the study area comprising the districts of Mathura and Agra. The remaining two districts, i.e. Etah and Farrukhabad lie as separate entity.

The relationship between changed agricultural productivity (Y_3) and the technological variables has been tested with the assumption that linear relationship existed in all the cases.

It is seen that the change in technological variables is directly proportional to the changed index of agricultural productivity. The variables which have high degree of relationship with changed agricultural productivity and are significant at one per cent level. These variables are tube wells and pumping sets (+0.41), iron plough (+0.37), tractor power (+0.49), fertilizer consumption (+0.64), area under high yeilding varieties of seeds (+0.41), irrigation intensity (+0.59) and rural electrification (+0.28). The variables which have weak or negative correlation are seed drills (+0.12), cooperative banks (+0.07), literacy rate (+0.08), size of land holdings (-0.13) and agricultural workers and cultivators (-0.07) (Table XXXIX).

The study reveals that the change in technological and insitutional variables is directly proportional to the change in overall development of agriculture in the study area. Therefore, to improve the agricultural situation in the region, it is urgently require to improve the infra-structural facilities in the region.

PART - III
SUMMARY

CHAPTER X

CONCLUSION AND SUGGESTIONS

Western Uttar Pradesh is a fertile area in the western portion of upper Ganga-Yamuna Plain. It is endowed with adequate resources and good climatic conditions which have favoured the practice of agriculture since times memorial. The growing population of the area engaged directly or indirectly demands more and more foodgrains and the farmers are forced to pay special attention towards the improvement in their agricultural output with an increased use of irrigation, fertilizers, high yielding varieties of seeds and the improvement in infrastructural facilities. There has been an increase in agricultural production but the distributional pattern of all the parameters are not equal in all parts of the region thereby leading to regional disparaties in the agricultural development.

Western Uttar Pradesh, as pointed out earlier is a monotonous level plain composed of old alluvium (bhangar) and new alluvium (Khadar). The region has a well developed drainage system. The rivers Ganga, Yamuna and Ramganga together with their tributaries make the three main systems of drainage. The area has a sub-humid climate because it lies between the dry Punjab plain and the humid eastern plain of Uttar Pradesh within the monsoonal regime of the great plain and naturally partakes the characteristics of the two adjoining regions. The soils of the region are of alluvial origin and are geologically grouped into three categories, i.e. 1) Khadar, 2) bhangar and 3) tarai.

The development of agriculture is a prime concern of planners, economists and geographers and offers a challenge to them to find out means and ways to bring out its overall reform. The development of agriculture implies optimum use of existing land resources with the help of scientific agricultural practices and the application of modern inputs. The development does not only involve an increase in the land productivity but also concerns with the provision of sufficient raw materials to run a number of allied agro-based industries.

Therefore, the main aim of researchers, planners and economists for the development of agriculture is to achieve the required amount of growth in order to bring out a marked improvement in the standard of living of people. The development of agriculture, beside other things, depends heavily on technological and institutional factors. The technological factors which are bound to bring out an increase in the agricultural production are irrigation, fertilizers, high yielding varieties of seeds, mechanization, use of pesticides and control of diseases. The institutional factors which upto a great extent are bound to affect agricultural production are number of operational holdings, consolidation of holdings, credit supply, cooperative banks and land tenure and land revenue.

There has been a marked improvement in the agricultural production in the region due to the spread and diffusion of technological and institutional factors from 1950-51 to 1990-91. The net irrigated area of the region was 42.42 per cent and total irrigated area was 40.06 per cent in 1950-51 but it increased to 80.08 per cent and 80.16 per cent respectively in 1990-91. The irrigated area by canals was 50.25 per cent in 1950-51 but it decreased to 22.60 per cent in 1990-91 mainly because of the onset of tubewell culture. Tubewell irrigation was unknown in 1950-51 but in 1990-91 it commanded 69.41 per cent of the cropped area. The area under other sources of irrigation has decreased considerably. In the year 1950-51 it was 49.72 per cent but it reduced upto 7.79 per cent in 1990-91 mainly due to the installation of tube wells on a large scale in the region. The high percentage in the net irrigated area was reported in the northern part of the study region and medium range increase was reported in the south central part of the region. The increase in irrigation facilities is the outcome of an increase in the number of pump sets and tube wells. The increase in irrigated area may be seen as a sign of farmers awakening and the beginning of a revolution which is silently taking place in Western Uttar Pradesh.

It has been observed that there has been a considerable increase in the indicators of agricultural development from 1970-71 to 1990-91 in the study area. The total area covered under high yielding varieties of seeds during 1970-71 was 3,842,541 hectares which went upto 9,185,715 hectares in 1990-91. The use of high yielding varieties of seeds are very common in the northern part and south central part of the study area while the area lying in the eastern part of the region has been slow in adopting this technology.

As far as consumption level of fertilizer is concerned, the NPK consumption is considerably increased in the region in the period of twenty years, i.e. from 1970-71 to 1990-91. The total consumption of fertilizers was 22.37 kg per hectare of cropped land during 1970-71, which shot upto 64.76 kg. per hectare of cropped land in 1990-91. The average consumption of NPK is higher in the northern and south central part of the region and low in other part of the Western Uttar Pradesh.

It has been observed that there is a considerable increase in the use of agricultural implements and machinary from 1970-71 to 1990-91. The average number of tractors in 1970-71 was 30.86 per 10,000 hectares of cropped land but it went up to 114.10 tractors per 10,000 hectares of cropped area in 1990-91. This indicates that the level of agricultural development is sharply increasing in the study region.

The number of cooperative banks in Western Uttar Pradesh has increased from 6.02 per lakh of population in 1970-71 to 38.94 cooperative banks per lakh of population in 1990-91.

The number of operational holdings are increasing owing to increasing pressure of population and the prevalent laws of inheritence responsible for the sub-division of holdings amongst the heirs. It is found that two categories of holdings, viz. below one hectare and those with 1 to 2 hectares in size constitute about more than 82 per cent of the total holdings in Western Uttar Pradesh. The other three categories with 2 to 4 hectares, 4 to 10 hectares and above 10 hectares in size constitute only 18 per cent of the total number of holdings in the study region.

There has been a considerable increase in percentage of literate persons to the total population in the study area. The percentage of literate persons to the total population during 1970-71 was 19.01 per cent and increased to 34.90 per cent during 1990-91.

The growth rates in area, production and yield in the region indicate that among all the crops, cereals are the leading crops. The area under cereals increased in all the quinquennial periods except in 1985-90 when it decreased by 396,951 hectares (8.73 per cent). But there is an overall increase in area under cereals to the tune of 1,007,753 hectares (32.08 per cent) from 1950 to 1990. The production of cereals recorded a continuous rising trend in all the quinquennial periods except in 1970-75 when it decreased by 218,899 metric tonnes (4.16 per cent). The production increased manifolds by

6,812,857 metric tonnes (284.64 per cent) during the study period. The yield also shows a continuous increasing trend during this period. The overall increase in yield of cereals was recorded as 191.20 quintals per hectare. The phenomenal increase has been achieved owing to the introduction of better seeds, expansion of irrigation facilities, use of fertilizers and pesticides and mechanization. The application of modern agricultural strategy is highly suitable for cereals cultivation. The production of cereals, however was affected by the prevailing dry conditions during 1970-71 owing to which production suffered a loss.

The areal extent of pulses suffered heavily in forty years. The area under pulses shows a continuous declining trend except in two quinquennial periods of 1955-60 and 1980-85. In all the forty years it decreased by 781,120 hectares (67.48 per cent). The production of pulses in the first ten years increased but later it started declining. The total loss was of 424,382 metric tonnes (50.74 per cent) during the study period. The yield of pulses, however shows a mixed trend. The yield during the period of 1950-55 was 1.14 quintals per hectare (15.78 per cent) increased slightly to 3.72 quintals per hectare (51.52 per cent) in 1990-91. Pulses are the main source of protein and therefore, in the light of their decline year after year, require serious attention of the farmers and governmental agencies. Efforts should be directed towards the increase of area and production of pulses. It can be achieved through the adoption of new varieties of seeds and by safeguarding the interests of the farmers.

A continuous positive growth rate in area and production of cash crops shows that the region, after getting self sufficiency in the production of foodgrains has turned into commercialised agriculture. It is observed that the area which previously was under the cultivation of pulses is being replaced by the cash crops mainly due to the increase in price of sugarcane and potatoes and creation better storage and transport facilities. The total increase in area under cash crops was 369,395 hectares (74.69 per cent) during the study period while the production increased by 25,881,932 metric tonnes (189.81 per cent) in the forty years. The yield of cash crops increased manifolds during the same period. During the period 1950-55 the yeild of cash crops recorded an increase of 12.75 quintals per hectare but it went upto 181.69 quintals per hectare during the study period, an increase of 65.89 per cent.

The area under oilseeds recorded a lenear growth of 254,882 hectares (247.40 per cent) while its production increased by 218,319 metric tonnes (355.08 per cent) in the forty years. The yield of cash crops increased by 21.97 per cent from 1950-1990.

The study of the spatio-temporal development with special reference to crop productivity reveals that in Western

Uttar Pradesh the productivity of cereals, cash crops and oilseeds has increased during the study period, i.e. from 1950-51 to 1990-91. The areal extent of high productivity region of cereals has increased by 496.03 per cent and medium productivity region by 44.01 per cent of the area under these categories in 1950-51. While the area under low productivity region of cereals decreased by 71.49 per cent of the area during the same period. The decrease of area under low productivity of cereals is due to the fact that most of the area has become an area of high and medium productivity in 1990-91.

The areal extent of pulses has decreased heavily under high and low productivity region categories. The area of pulses under high productivity region has decreased by 462,659 hectares (85.31 per cent) and under low productivity region by 391,390 hectares (70.50 per cent) during the study period. But it gained a little area under medium productivity region, increasing by 50,147 hectares (69.31 per cent) since 1950-51 to 1990-91. The decrease in area under pulses is a matter of concern, since pulses constitute the chief source of protein for the population of the study region. The low yield of pulses shows that it has not been benefited by the modern inputs. The use of indigenous seeds, lack of financial resources and non-use of chemical fertilizers make the yield static or even lead to its decline. The improved quality seeds like T-21 and T-44 need to be introduced which can thrive well with less irrigation and give higher net return to the farmers.

The areal extent of cash crops in all the three productivity regions have increased considerably. The area of cash crops under high productivity region increased by 46,305 hectares (16.51 per cent) during the study period. The highest increase in area of cash crops was recorded under medium productivity region whereas it increased by 403,926 hectares (452.64 per cent) and under low productivity region by 98,774 hectares (145.00 per cent) from 1950-51 to 1990-91. The increase in area under cash crops is due to the decrease in the area of pulses during the study period. It has been observed that the area of pulses in replaced by the production of cash crops in the study region.

The areal extent of oilseeds has increased in all the three productivity regions from 1950-51 to 1990-91. The study reveals that the areal extent of high productivity region of oilseeds has increased by 161,184 hectares (1749.71 per cent), medium productivity region by 177,304 hectares (1027.19 per cent) and low productivity region by 30,097 hectares (52.77 per cent) from 1950-51 to 1990-91. It shows that farmers of the study region are cultivating oilseeds for commercial purposes instead of pulses which showed a continuous decrease in area during the study period. The increase in area under oilseeds is mainly due to better farm management, use of good quality seeds and higher net-return.

There is an overall increase in area under high and medium productivity regions from 1950-51 to 1990-91. Its areal extent under high productivity region increased by 884,870 hectares (79.52 per cent) and by 1,877,254 hectares (126.40 per cent) under medium productivity regions from 1950-51 to 1990-91. The areal extent of low agricultural productivity in Western Uttar Pradesh has decreased by 122,537 hectares (53.00 per cent) during the same period. The reduced area of low agricultural productivity region is at the cost of high and medium productivity regions which have increased their area. Thus it gives a rising trend of overall agricultural productivity of the Western Uttar Pradesh.

The impact of modern technology on agricultural development is seen by firstly, determining the inter relationship between independent variables and secondly, by determining the precise role of various indicators of agricultural development through factor analysis from 1970-71 to 1990-91. The study reveals that there exist inter relationship among independent variables. The results of the analysis for 1970-71 indicate that each variable when considered as a dependent variable has high positive correlation with about 70 per cent of the variables selected. The cooperative banks are having very weak positive correlation with all the variables, size of land holdings is having negative correlation with all the variables except iron plough and agricultural workers & cultivators. while agricultural workers & cultivators have negative correlation with all the other variables except with size of land holdings and iron plough.

While studying the inter-relationship among independent variables for the year 1990-91, it is found that each variables is having a high degree of positive correlation with about 74 per cent of the variables selected. Nearly all the variables have negative correlation with size of land holdings and agricultural workers & cultivators.

The results of the factor analysis for the year 1970-71 show that 75.34 per cent of the total variance is explained by two factors. Factor I explains 61.10 per cent of the total variance explained. The highest positive loading is shown by high yielding varieties of seeds (0.903) follwed by tractor power (0.897), irrigation intensity (0.879), tube wells & pumping sets (0.865), seed drills (0.844) and fertilizer consumption (0.840). Factor II accounts for 14.24 per cent of the total variance explained and is strongly loaded with about 28 per cent of the variables selected. The highest positive loading is shown by size of land holdings (0.886) followed by agricultural workers & cultivators (0.796) and iron plough (0.712).

The factor analysis for the year 1990-91 shows that 84.97 per cent of the total variance is explained by three factors. Factor I accounts for 62.53 per cent of the total variance explained. The positive sign of variables is associated with the higher development of agriculture and infrastructure. Irrigation (0.942), fertilizer (0.965), tractorization (0.941), tube wells & pumping sets (0.901) and high yielding varieties of seeds (0.822) are all loaded high'and positive on this factor.

The positive relationship among these variables of agricultural development is because the use of fertilizers and HYV seeds require high doses of irrigation. Mechanization constitutes an increasing ingredient of modern agriculture.

Factor II accounts for 13.65 per cent of the total variance explained and is closely related with variable of cooperative banks (0.915).

Factor III which explains 8.79 per cent of the total variance explained and is positively loaded on size of land holdings (0.916), agricultural workers & cultivators (0.732) and seed drills (0.455).

The results of the factor analysis performed for three agricultural productivity regions in Western Uttar Pradesh for the year 1990-91 shows that the rotated factor matrix for each of the three regions recorded two factors but the per cent of the cumulative variance explained are dissimilar. In the high productivity region, the total variance explained is 79.23 per cent. Factor I recorded 58.90 per cent of the total variance explained and have positive loadings on about 66 per cent of the total variables selected. These are tube wells & pumping sets, tractor power, fertilizer consumption, high yielding varieties of seeds, irrigation intensity, rural electrification, cooperative banks and literacy rate.

Factor II explained 20.33 per cent of the total variance explained and has high positive loading on about 16 per cent of the total variables. These are seed drills and tractor power.

Medium productivity region recorded 75.02 per cent of the total variance explained by two factors. Factor I explained 48.33 per cent of the total variance explained and is strongly loaded on about 33 per cent of the total variables. Factor II recorded 26.68 per cent of the total variance explained and has high positive loadings on seed drills (0.768) and tractor power (0.909).

Low productivity region explained 75.40 per cent of variance by two factors. Factor I which explained 30.15 per cent of the total variance is strongly positive loaded on about 25 per cent of the variables. Factor II recorded 45.25 per cent of the total variance explained and has high positive loadings on about 25 per cent of the total variables.

In the high productivity region, the combination I comprises of tube wells & pumping sets, tractor power, fertilizer consumption, high yielding varieties of seeds irrigation intensity, rural electrification, cooperative banks and literacy rate. This combination is ideally suited for the development of agriculture in Western Uttar Pradesh.

In the medium productivity region, there are two combinations, i.e. combination II which is comprises of tube wells & pumping sets, fertilizer consumption, high yielding varieties of seeds and irrigation intensity and combination III comprising of the variables of seed drills and tractor power.

In the low productivity region, combination IV comprised of the variables of tube wells & pumping sets, high yielding varieties of seeds and irrigation intensity and combination V which is combined with the variables of seed drills, fertilizer consumption, size of land holdings and agricultural workers & cultivators are well suited for agricultural development in the study region.

The results of the study indicate that the impact of independent variables is less significant for agricultural development of Western Uttar Pradesh as a whole comparison to the three regional productivity areas of this plain. The results further substantiate that the regional sensitivity of packages of variables have different influence in different agricultural development regions. This does not mean that these packages will not have similar effects in the region, instead it reveals causes of variables in regional development of agriculture.

The levels of agricultural development in the region are seen in three respect, i.e. the changed cultivated area is correlated with the change in modern technology; the changed agricultural production is correlated with the change in modern technology; and finally the changed agricultural productivity is correlated with the change in modern technology. The study reveals that about 50 per cent of the districts have increased their agricultural area between the grade of 0 to +100,000 hectares and about 14 per cent above 100,000 hectares in 1990-91. About 35 per cent of the total districts have decreased their agricultural area between the grade of 0 to -100,000 hectares except Meerut district in 1990-91. When the change in cultivated area is correlated with the change in technological variables, it is found that about 33 per cent of the variables are directly proportional to the changed area. Only the size of land holdings has a high positive correlation.

About 40 per cent of the districts which have increased their production in the grade of above 1,000,000 metric tonnes lie in the Ganga-Yamuna doab and in the eastern and north eastern parts of study area. About 20 per cent of the districts fall between the grade of 500,000 to 1,000,000 metric tonnes increase in agricultural production. About 21 per cent of the districts increased agricultural production between the grade of 100,000 to 500,000 metric tonnes and about 14 per cent of the distrcits have increased their agricultural production in the grade of below 100,000 metric tonnes. The study reveals that there exist some relationship between the changed agricultural production and change in independent variables but their relationship is weak and not uniform. About 75 per cent of the variables are directly proportional to the development of agricultural production in Western Uttar Pradesh.

While studying the change in agricultural productivity and change in the variables of agricultural development, it is found that about 21 per cent of the districts have decreased their agricultural productivity index between the grades of 0 to -20 quintals per hectare and above -20 quintals per hectare. Nearly 21 per cent of the districts have a marginal positive growth of agricultural productivity between the grade of 0 to +20 quintals per hectare. About 56 per cent of the districts have increased agricultural productivity above 20 quintals per hectare. The study reveals that the changed agricultural productivity has high degree of positive relationship with tube wells & pumping sets, iron plough, tractor power, fertilizer consumption, high yielding varieties of seeds, irrigation intensity and rural electrification.

An overall assessment of the problem reveals large variations in the agricultural development at micro level in Western Uttar Pradesh. The general distributional pattern of agricultural development shows a marked decline from north to south. This pattern is in close conformity with the variations in the level of agricultural technology. The districts having relatively higher agricultural productivity are technologically more advanced. On the contrary, the districts which have been backward are still lagging behind in the use of modern monetized inputs. The developmental pace in the right direction can however, be accelerated if certain changes are incorporated in the existing infrastructure facilities. Irrigation facilities need to be increased in areas where they are non-existant. The quickest way would be digging of tube wells. The supply of electric power and diesel oil at controlled rate in areas which lack in irrigation facilities will further help the farmers in operating tube wells. Canals do not have adequate supply of water during dry season owing to which crops suffer. If the facility of canal water is provided to the farmers throughout the year it is bound to yield beneficial results. The less developed districts of the region require proper and timely supply of electricity to operate the electric pump sets during the period when the crops require water for their successful growth. Distribution of chemical fertilizers and high yielding varieties of seeds in general and in the districts lagging behind in particular should be distributed only through the cooperative societies on subsidies rates so that the farmers can get it in time and the quality can also be assured. Tractors and other costly agricultural machinery should be provided with reasonable interest to small and poor farmers so that they can afford to purchase these implements.

The distribution of loans as well as financial assistance agencies are lacking in various districts. The emphasis therefore, should be given to increase per capita loans and establish loan societies. Moreover, the procedure for obtaining loan which is presently complicated and time consuming should be made easy with social justice. The size of land holdings in the region is decreasing year after year due to the increasing pressure of population and the law of inheritance which inhibits the use of modern implements and machinery. The consolidation of holdings is urgently required in all the districts of the region so that the farmers can use modern technology which facilitate multiple cropping and also diversification and commercialization of agriculture. To further improve the condition of agriculture in Western Uttar Pradesh it is necessary to restore the land of actual tiller or manage it through cooperatives.

The present study has succeeded in demonstrating intra-district variations in agricultural development as well as in delineating problem areas in Western Uttar Pradesh. It has also succeeded in confirming the hypothesis of inter-relationship between agricultural development and improvement in technological and institutional facilities. Therefore, in the light of study conducted, the researcher is confident that if the above mentioned suggestions are adopted, the agricultural development in the region can be achieved in its true sense.

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